# ENGINEERING NEWS

THE most important series of brake tests which have ever been made are now in progress at Burlington, Ia., and are likely to be for some weeks yet. They are the most important because they are not simply nor chiefly devoted to the comparatively unimportant question of precisely how quick a stop can be made with already approved devices in all but universal use, as was the case with the passenger brake tests made six or eight years ago in England, but because they are settling the great question of what brake is to be used on the whole freight car equipment of this country, which it is quite certain must be equipped with power brakes of some kind within a few years, and which constitute fully three-fourths of the rolling stock of the country. Moreover, the ground has been cleared for the present tests by the similar work done last year, when some very imperfect brakes were weeded out altogether, and ample room was found for improvement in each of the brakes which went through the ordeal. Each of them has made these improvements, and although a number of brakes now appear for the first time, yet they have for the most part already endured such tests as to ensure that time will not be wasted in testing them.

Brakes actuated in any way by electricity are now publicly tested for the first time, and they have already shown that they possess very decided advantages. When air only was used to actuate the brakes on long trains, as in last year's test, there was not only a great loss of time in getting the brakes fully on throughout the train, but there was a terrific shock at the rear of the train, due to this inequality of time in application. This year, not only has this shock been *completely* eliminated, but the average efficiency of the brakes on long trains has been more than doubled, *i. e.*, made as great as it is on the locomotive only, or on very short trains, This is a great gain indeed, indicating strongly that electricity is likely to be a feature of the freight brake of the future.

Some very remarkable stops have already been made, such as stopping a train moving at 21 miles per hour on a one per cent. down grade (53 ft. per mile) in the unprecedented distance of 163 ft. The quickest stop made by any train last year at this location was 320 ft., and nearly all ran well over 400 ft. This, however, is not nearly so remarkable a contrast as it appears, for when the brake performances are contrasted in the only proper way to contrast them, viz., in per cent. of the retardation in pounds to the load in pounds *on the braked wheels*, it is found that the per cent. of efficiency this year is not appreciably greater than it was last year, but all the short trains in last year's tests had a large proportion of their weight unbraked, while all the long trains had the efficiency of the brakes reduced by the cause mentioned. The last year's performances with short trains were almost identical with this years', as appears more fully elsewhere, leaving as the net progress shown this year—and it is an enormous one—the complete elimination of shock, and of all contrast in the efficiency of brakes on long trains and short ones.

Three driver brakes have so far been tested, the Westinghouse, Eames and Carpenter. The Westinghouse performance was a shade off from last year but practically identical, viz.:

| | Last year. | This year. |
|---|---|---|
| Average efficiency, first run (4 stops) | 8.38 | 8.84 |
| " " second " " | 11.39 | 10.21 |
| " " both " " | 9.88 | 9.52 |

The Eames was very decidedly off from last year, its average efficiency being only 8.17 per cent. against 10.46 per cent. last year or a little more than the Westinghouse. These tests of a single set of brakes in one or two runs, however, are more or less a matter of chance, as will be seen in the contrast of the first and second runs of the Westinghouse.

The Carpenter did finely, the best of all the driver brakes, but not so well as the American (steam driver brake) did last year, when it showed an average of 12.35 per cent. against 10.72 of the Carpenter.

The supposed advantages of the close-coupling hook or "vertical plane" couplers, which seemed to be established by a single trip made last year, which showed an extraordinary gain therefrom, have had grave doubt thrown on them by this year's tests, when some of the most terrific shocks on record have resulted from the stops made with the Janney close coupler. So far, the close couplers have developed no advantage in this respect whatever, but as remarkable results were clearly shown last year, the case must be regarded as still open.

THE Trustees of the Brooklyn Bridge met on May 18 to consider a new plan for increasing the New York terminal facilities. This plan proposed a new central station for outgoing passengers, with the landing of all incoming passengers on the present platforms; this arrangement would enable the cable to be used to its full capacity with six-car trains. This center platform would be 19 ft. wide and would obviate the present packing of passengers at the head of the stairs; the change in switching would, however, change the arrangement of the promenade leading into Park row. Another plan discussed suggested the dispensing with switching locomotives and an additional cable; this arrangement would complete the development of the railway system on the bridge, though it was suggested that tramways could ultimately be put upon the roadways worked by a horizontal grip and side cables. It would cost about $50,000 to carry out the plan first proposed, which appears to be in essential features identical with a plan prepared by Mr. F. COLLINGWOOD some five years ago, when he was making a study of the New York approach.

THE Harlem river bridge now under construction has been officially christened the "Manhattan" bridge, and will hereafter be so called.

THE Legislative Conference Committee, of Connecticut has agreed upon a bill for the removal of grade railway crossings. It requires 250 of the more dangerous to be removed at the rate of at least 2 per cent. and not over 10 per cent. a year. The railroads must pay at least 40 per cent. of the cost and 3 per cent. additional for each one per cent. of dividend paid, so that a road paying 10 per cent. dividend would pay 70 per cent. of the cost of the work. The State must pay the rest. The proposition seems to be a sensible and reasonable one, and our other States sooner or later must follow.

THE floods still continue in New England and New Brunswick, but the water is now subsiding. The Androscoggin river has not been so high for 60 years and the country along its course is flooded. In New Brunswick, St. John, Fredericton, Woodstock, and several smaller places, are still flooded. The Intercolonial and New Brunswick railroads, and the Aroostook branch of the latter, have been flooded and 3 washouts have occurred. The stone dam at the outlet of Lake Umbagog has been carried away. The Nerepis bridge, which cost the province of New Brunswick $200,000, was swept away May 11, the bridge at Milan, N. H., is damaged and will be wrecked and an iron bridge on the Petersburg & Weldon Railroad, in Virginia, has been washed away. Further particulars show serious results of the earthquake in Mexico, two towns destroyed and several greatly damaged, the loss of life is considerable. A slight earthquake shock was experienced at Charleston, S. C., May 13.

THE most serious railroad accident of the week occurred May 13 and was due to a collision on the Mobile & Ohio Railroad near Waynesboro, Miss. A passenger train ran into a locomotive, the driver of which was running by an old time table. One man was killed and two injured.

THE Pennsylvania Railroad Company is steadily pursuing its policy of replacing iron with stone bridges wherever possible. Sixteen stone bridges have been built on its lines within the last two years, and a number of other very important ones are now under construction or about to be commenced. As an example of the ultimate economy of so doing, the Conemaugh viaduct on the west slope of the Alleghanies is cited; this stone structure was built in 1852 and has not cost $50 since then for repairs.

THE Royal Commission on the Montreal floods have made their report to the Canadian parliament and recommend the construction of a temporary dyke along the river front for immediate protection against spring floods. The completed plan involves the widening of Commissioner St., in Montreal. Estimates show that the cost of a new revetment wall so placed as to give a width of 100 ft. to Commissioner St., and to retain the present wharf level would cost, with timber construction, $1,200,000; to raise the level of the street and dyke, as demanded by the present commerce, would cost $1,700,000. As time is too short to provide permanent works before another flood, a temporary dyke to cost $50,000 is recommended. The Commissioners are, THOS. C. KEEFER, HENRY F. PERLEY, JOHN KENNEDY and PERCIVAL ST. GEORGE.

ON May 5 ground was broken for the Colorado Central tunnel. This is to form a part of one of the largest mining operations in Colorado, and will be utilized in developing the property of the Colorado Central Consolidated Mining Co. The new tunnel starts on the north slope of Leavenworth Mountain and will be 4,500 ft. long, passing 2,000 ft. below the apex of the mountain. It will be 8 x 7 ft. in cross-section.

THE *Indianapolis Journal* states that split switches are being substituted for stub switches on the Union tracks, and belt roads around the city. It is about time. The usual rule that the West is the first to adopt desirable improvements, which has held true in so many cases, has been reversed in the case of stub switches, which ornament western yards and main lines to a quite improper extent. The stub switch was the direct cause of the terrible Rio disaster last year, and is constantly causing minor ones.

THE City of Philadelphia has been compelled by an award of the Court of Common Pleas to pay $9,243.92 as damages to a property-holder arising from the breaking of a sewer in front of his house. The testimony showed clearly that the sewer was unskillfuly constructed by the contractor.

THE elevated railway question is again up before the city councils of Philadelphia, the inciting cause being the proposed ordinance authorizing the construction of the Philadelphia & Northwestern Railroad, to enter the city from Frankford and pass down the Delaware river front. Mr. JOS. V. MEIGS, of Boston, explained to councils the good qualities of his system.

*Engineering* scolds the British Government for the existing lack of surveys for the extension of the Quetta Railroad into Afghanistan. The territory has been virtually in English possession for 10 years, but it is only now that anything is being done in the shape of investigating a really very difficult engineering problem. To get the line over on the Candahar side of the mountain they must pass from Gulistan, the present terminus of the railroad 5,000 ft. above sea-level, over the Khojak Pass which is 7,200 ft. high; the distance in which this ascent is to be made is not noted, but the pass lies some 60 miles beyond Quetta and is 90 miles from Candahar, as the crow flies. *Engineering* remarks that the Russians or Germans would not have so long delayed such important details.

A REPORT to the Department of State on the coal mines of New-South Wales, states that the area covered by the seams is estimated at 25,950 square miles, extending from the interior to the water's edge. These deposits are said to be among the most extensive and valuable in the world and some of the highest authorities on minerals, both in England and Australia, are decided in the opinion that the New-South Wales coal in many respects is superior to English coal. The Consul says that the exports of coal to San Francisco and other ports of the Pacific Coast of the United States have steadily increased during the last few years. The low cost of freight and the drawback, 75 cts. per ton, allowed upon coal imported into the United States for the use of foreign and domestic steamships are the principle causes of the increase.

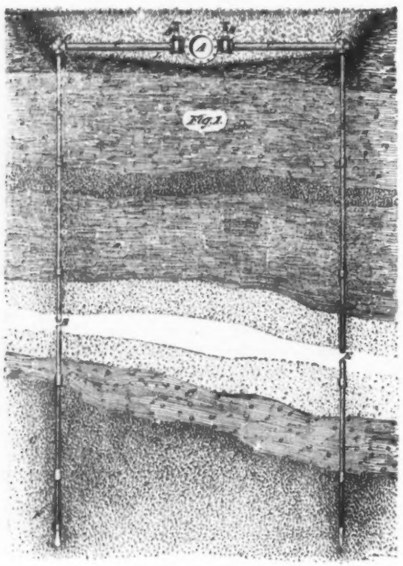
## Sub-Surface Water Supplies.*

BY PROFESSOR W. P. TROWBRIDGE.

Two or three years ago I prepared a paper for the *Sanitary Engineer*, describing the driven wells, and the method of connecting them with pumps, by which a large supply of pure water had been obtained for the city of Brooklyn from the gravel deposits on Long Island. The simplicity of the means adopted and the large and constant volume of water obtained were alluded to as constituting a new and successful experiment on a large scale in connection with the supply of water to towns.

Since the publication of the paper referred to, the Messrs. ANDREWS & CO., contractors, have established two additional "plants" along the line of the Brooklyn Aqueduct, increasing the supply for the city to 18,000,000 galls. daily from this source alone, —a quantity equal to one-sixth of the supply to the city of New York at the present time.

This large volume of water is obtained from four hundred and sixty (460) 2-in. tubes (equivalent in area of cross section to a single tube or pipe 44 ins. diameter) driven from 40 to 70 ft. into the gravel deposits. On a trial-test, these tubes have furnished




27,000,000 galls. in twenty-four hours. 18,000,000 is not, therefore, the maximum supplying capacity of these wells at this time.

It is not contended that there is anything novel in the idea of obtaining water for any purpose from the unconsolidated or loose detritus of the earth's surface; but the means and appliances, by which such large quantities are drawn continuously and permanently from a few tubes driven into the ground, are so effective and simple, and so much has been done to encourage further operations of the same kind, and to throw light upon the characteristics of these underground water-bearing deposits that it may be said that new resources, in connection with the water supply of the largest towns, have been opened to the engineer—resources not *always* available, it is true, but in many cases highly practicable and economical.

The engineer who seeks a source from which may be obtained a proper supply of water for a town, must take into consideration a great variety of circumstances. Among these, the meteorological and geological conditions which prevail in the district are most important, since these influence the quantity as well as the quality of the water obtained. Of all meteorological agencies, there are none which have more controlling influence on the physical geography of the globe and the adaptation of any part of its surface to the necessities of the human race than those which relate to rainfall and the reflux of the condensed waters to the sea. The causes which determine the quantity of rain which falls in any region are various; ocean currents, aerial currents, mountain ranges, extended valleys and plains,—all produce their effects; and, although the most varied extremes occur of regions where vegetation is luxuriant on the one hand, and where deserts exist without rainfall on the other, yet such is the constancy of nature in her great cycle of changes, that each place receives its appointed share almost unchanged from year to year.

*From "The School of Mines Quarterly," April, 1887.

The average rainfall of a region is, therefore, in most civilized countries, one of the best established of all meteorological phenomena.

It is not so, however, in regard to the return of the waters to the sea. The flow of surface streams may, it is true, be determined with approximate accuracy, and their courses are well defined; but the disposal by nature of that large part of the rain which does not appear in the rivers and brooks, as they accumulate in magnitude towards the sea, is involved in much obscurity. A portion of the condensed vapors is known to be absorbed by plants, and a portion is reëvaporated, but a still greater part, apparently, disappears beneath the earth's surface. By what precise channels this large volume of water ultimately reaches the ocean, how much of it enters the covered out-crops of porous strata and finding its way deep into the earth's crust between underlying and overlying consolidated beds, is ultimately discharged underneath the waters of the ocean; how much enters faults and fissures, and again issues in springs of pure or mineral waters; how much is concerned in excavating underground courses through or among the softer or more soluble rocks, or follows channels already thus excavated, is not and cannot be known. But that no inconsiderable portion of this subterranean flow follows more shallow channels in the loose detritus upon the surface seems probable. In most countries where the rainfall is copious, moderate excavations at the surface reveal the presence of water. In our own country every farm has its well, whether it be situated on a hill or in a valley; and, while these wells occasionally become dry in very dry years, it is apparently, in most cases, because they have not been sunk deep enough to reach those water-bearing beds of gravel and sand, from which a perpetual and continuous supply might be obtained. The farmer, in sinking a well, looks gratefully for the first indication of water, and as his needs are not excessive, the sinking of the well is stopped when the upper surface of the first water-bearing stratum is reached. The methods and appliances at his command do not permit him to sink deep into watery ground.

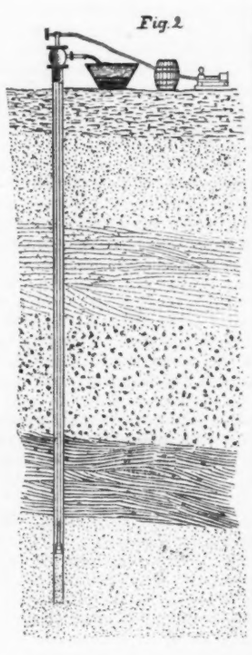
The "driven well" goes deeper, and the tube is easily driven through soft ground to any desired depth; while the artesian boring proper pierces the solid strata still lower, if necessary, and draws its waters from sources more distant than those which supply the common or the driven well.

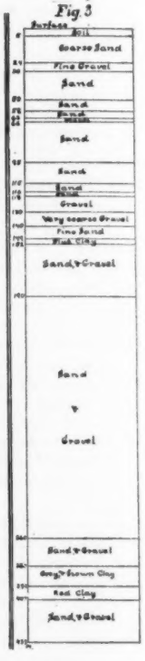
The proportion of the rainfall which passes off by the surface streams is so variable in different places, that actual gaugings of the streams is generally necessary to determine it. Over a large portion of our northern states, this proportion is from 30 per cent. to 90 per cent. of the rainfall, depending upon the seasons, the surface topography, and the geological characteristics of a district. From 10 per cent. to 70 per cent. of the rainfall for the same localities disappears, being absorbed by plants, reevaporated from the surface, or sinks beneath it, and of this latter portion there is no doubt that, in many parts of our country, nearly all follows shallow sub-surface channels slowly to the sea-levels.

Artesian wells have become so common in every quarter of the globe as to no longer excite especial interest, beyond that which may be attached to the great depths of some and the large volume of flow from others. As a general rule the hard or consolidated strata of the earth's crust have to be pierced, often at very great depths, to reach water-bearing strata which have been pointed out by precise geological knowledge, or which are sought for with much expense and uncertainty where such knowledge is wanting.

While the mechanical processes of boring these wells have reached such a degree of excellence and certainty that individuals or companies may now be found ready to undertake for a specified sum per foot the sinking of an artesian well to any reasonable depth, yet the great cost and the uncertainty of success, of any one boring as regards the volume of water which may be permanently obtained, causes this method of search for water to be adopted for cities and town only as a last resort.

If it be proper to classify the systems which have been referred to as the "artesian" and the "driven well" systems, it can be said of the latter that the methods of exploration and well-sinking which have been recently developed seem to offer incontestable advantages, and to promise results of the greatest value and importance. Facts have been established in the explorations already made in different places, which seem to offer strong inducements for further and and systematic researches, not only from an economic but from a scientific point of view. Among the scientific questions presented, those which appear to be of special interest relate to the causes of some of the peculiar phenomena of disposition and arrangement presented in the interstrati-




fied beds of gravel, clay and sand which are found to exist; and, if these are connected in any way with ancient river beds, the possibility of tracing out these beds with greater certainty.

A study of these surface deposits by the methods which have been introduced for the driven wells, and which is attended with little difficulty and expense, comparatively, seems to offer, at least, an attractive field for economic and and scientific explorations.

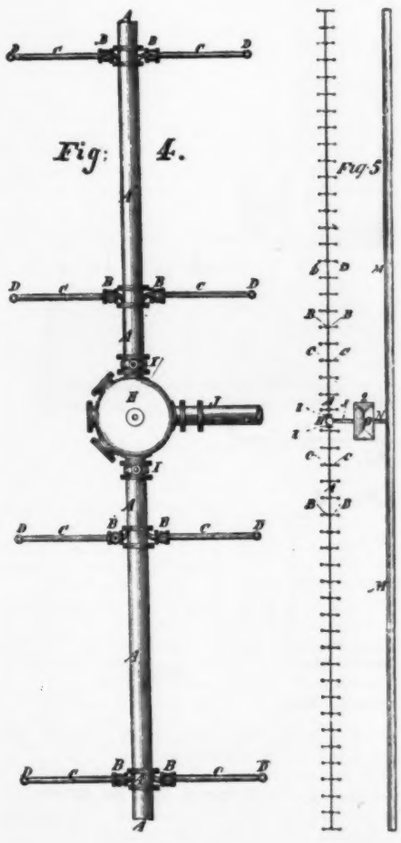
Through the kindness of Mr. W. D. ANDREWS, I have obtained sketches which illustrated the construction of one of the four "plants" on Long Island from which the supply above mentioned is obtained, and also a sketch illustrating the process of boring or prospecting adopted; and another representing a section of the deposits of sand, gravel, and clay in the vicinity of one of these plants to the depth of 433 ft.

In these sketches Fig. 5, represents a plan of the whole "plant." The system of driven tubes occupies a space about 800 ft. long and 15 ft. broad, parallel with the line of the Brooklyn aqueduct. The tubes are in two rows about 15 ft. apart, while in each line the tubes are about 12 ft. apart. Fig. 5, shows the relative position of the Brooklyn aqueduct, *M*, the pump house, *O*, and the driven wells in two rows *D D*, Fig. 4. Fig. 4, is an enlarged view of a portion of the plan. In this sketch it will be seen that each tube is connected with a large pipe *A*, lying widway between the two rows of driven tubes and connecting them with a central or common chamber *H*, from which the suction pipe *J* extends to the pump house. In this Fig. the connecting pipes *C C*, and the junction *B B* are shown more clearly than in Fig. 5.

The pumps in the pump house *O* draw water from all the wells simultaneously and discharge it directly into the aqueduct through the pipe *N*. (Fig. 5).

Fig. 1 represents a vertical section through two driven wells, showing the extension of the tubes downward through several strata of sand and gravel to the lower stratum *G*, from which the supply is drawn. The ends of the tubes are pointed to facilitate them being pushed downwards, and are perforated for several feet in length near the ends to permit the entrance of the water. The perforations being covered with a wire netting to prevent the introduction of large pieces of gravel.

Fig. 2 illustrates the apparatus for prospecting for water. A two inch tube is driven down for a few feet at the surface with fittings at the top which close the top except that a spout shown in the figure is attached to discharge water, sand, gravel and clay into a tub. These fittings permit of a smaller tube being inserted into the top of the larger with a hollow handle connected with a flexible hose to a portable pump. A man by grasping this hollow handle can churn the inner tube up and down while water is being forced into it from the pump. The bottom of this inner tube is chisel-shaped, but there are two







openings near the bottom which permits the water pumped through the inner tube to enter the space between the inner and outer tubes near the bottom. The churning action cuts up the sand and gravel, and as it is mingled with the water forced in, both the water and sand or clay are forced to the surface upwards between the two tubes and discharged into the tub.

A barrel or portable tank supplies the water if necessary. The specimens discharged into the tub are collected and preserved and thus a complete section of the strata may be obtained. The tubes may be extended by adding sections at the top as the boring extends downwards. Fig. 3 shows the section obtained near one of the plants on Long Island to a depth of 433 ft. Two of the gravel deposits passed through were composed of coarse rounded gravel, almost wholly free from any admixture of fine sand or clay, an evidence that there is a continued flow of water among the particles of gravel.

Mr. HENRY E. KNOX, Jr., formerly a student in the School of Mines, has been for many years engaged under the direction of the Messrs. ANDREWS in prospecting for water in various places, and I am indebted to him for the description of the prospecting device just described.

Mr. KNOX found, between Albany and Troy, an extensive bed of gravel beneath a bed of fine clay, from 16 to 25 ft. thick near the surface. The gravel bed is from 17 to 35 ft. thick, about 700 ft. wide, and of indefinite length, it having been traced about half a mile longitudinally.

The gravel from this bed is entirely different from that on Long Island. It is composed of coarser grains or fragments of dark colored rock, nearly all of uniform size, and less rounded than those from Long Island, showing evidence of that kind of attrition which comes from running water rather than wave action.

Mr. KNOX found precisely the same gravel in his explorations near Utica: and under a bed of clay, 118 ft. thick, near Albany, he found a bed of clean gravel, of nearly uniform size and uniform material, but composed of angular, water-worn pebbles as large as pigeons' eggs.

One of the most important questions connected with the system adopted on Long Island, and which has been repeated elsewhere on a smaller scale, was the permanence of the full supplying capacity of the wells.

It was urged by some distinguished engineers that the tubes must tap sheets or reservoirs of still water, and that a continued draught upon the system must speedily exhaust the reservoirs.

Experience has not confirmed this view. Mr. KNOX informs me that, of the 1500 or 2000 wells selected and driven by himself, not more than two or three have ceased to act, and that in nearly all the supply remains undiminished.

Experiments were made on Long Island to determine the line of depression of the water-level in the ground immediately adjacent to the plant of 100 wells, while the pumps were drawing to their full capacity.

Test wells were sunk just outside of the plant on four sides, and a line of test wells extended out to a distance of 4,000 ft. from the pump-house. Observations were made during three months. At the distance of 4,300 ft., the water-level was reduced about 6 ins. At a distance of 2,300 ft. about 2 ft. 2 ins., and in the immediate proximity to the wells, within a a distance of 300 ft., the depression was 4 ft. 8 ins. When the pumps were stopped, all the levels were restored.

The rate of flow to wells sunk in sand or gravel depends, of course, upon the compactness of the material of the water-bearing stratum, the resistance to the flow being proportional to the narrowness of the minute channels through which the water must flow, and to the number of winding and turnings which a particle is forced to take throughout its course to the pumps. The velocity of a particle of water running into an ordinary filtering gallery along the margin of a stream is generally less than one foot an hour. The velocity of a particle flowing towards the pumps in the driven-well plant on Long Island, taken a little outside the rectangle formed by the hundred wells, is about the same—a velocity too small to be directly perceptible to the eye. This small velocity shows what great relative resistances are encountered.

The form of the water-surface will, therefore, depend almost entirely upon the coarseness or compactness of the materials through which the water passes, and is not to be taken as a measure of the degree of exhaustion of the source of supply.

In all the explorations thus far made, it has been found that the gravel-beds, available for water, are not continuous over indefinite areas, nor of uniform thickness, but certain beds and particular channels in certain bed appear to constitute the underground water-ways, rendering systematic explorations necessary.

The questions which naturally arises, concerning these deposits, are: What have been the causes of the peculiar arrangements of sand, gravel and clay? Are the gravel deposits the beds of ancient water courses, along which the finer sands and clays have been washed away by the streams? Can these old river beds, if they exist, be traced and identified throughout their courses?

In the exploration between Albany and Troy, the appearance of the gravel found seems to indicate a common origin with that at Utica, and it is the opinion of Mr. KNOX, that the same beds extend along the valley of the Mohawk between these points, but by a route not identical with the present course of that river.

The mode of exploration which has been described, renders it more simple and less expensive than might be imagined to conduct such researches, although not probably within the resources of private explorers.

An instance has recently come to my knowledge which adds new interest to this subject, inasmuch as in this case water was procured in abundance from a sub-surface deposit in loose material in a region where the small rainfall and the absence of permanent surface streams has heretofore been considered a serious obstacle to any permanent settlement of the region.

Mr. ARTHUR MACY, a graduate of the School of Mines, having been appointed to take charge of the famous "Silver King" mine in southwestern Arizona, found that for the extensive milling operations that would be necessary in the treatment of the ore, an amount of water would be necessary for which no adequate supply appeared available. A valley of several miles in extent lay above the mines and from the appearance of the country, he concluded that this valley, from which flowed a small torrent in the rainy season, must contain subsurface water. He excavated two open wells, one 15 ft. and the other 25 ft. deep, at the outlet of the valley, and about 300 ft. above his mills in vertical elevations and 3 miles distant from the mills.

A 3-in. pipe was carried from the mills up the valley to the wells, where it was connected to two syphons, one from each well; through these syphons, without the use of pumps, he obtains a continuous supply throughout the year of 200,000 galls. per day.

There is no doubt that Mr. MACY has thus discovered a practicable method of obtaining water in Arizona, which may be repeated in many parts of that territory and which will be found applicable in many other regions heretofore supposed to be practically deprived of water.

There is now at least, abundant experience to encourage the search for and use of subterranean water for the most important uses of life in the shallow and loosely compacted deposits which cover plains and valleys. Another significant example is found in the new water-supply for the villages on the east shore of Staten Island. A large part of this island is known to be covered with drift. That portion which is embraced between the principal ridge of serpentine rocks running through the middle of the Island from north to south, and the dyke of basaltic rock which skirts the western shore of the island, both of which have been described by Mr. BRITTON before the New York Academy of Sciences is especially to be noted as bearing water; a very large part of the rainfall, doubtless, because the whole area of 8 or 10 sq. mls. is peculiarly devoid of surface streams.

Along the southwestern shore of the island there are unmistakable indications that the underground flow reaches the surface only a few feet above high water mark. Here the Crystal Water Co. have sunk large tubes about 40 ft. into the drift. From these tubes the water destined for the village along the eastern shore of the Island is pumped to a reservoir, 3½ mls. distant, situated on the top of the dividing ridge referred to, whence it descends through pipes by gravity about 2½ mls. further to the eastern shore, furnishing a head of about 250 ft.

A few years ago Staten Island and Long Island were supposed to be almost destitute of water when the prospective wants of their large and increasing population were considered. Now it may be said, that in this respect, though isolated from the main land, they are better off in many respects than New York City. I recently examined at the request of the Trustees of the village of Edgewater the facilities presented on Staten Island, and had no hesitation in advising that a contract might be safely made with the Crystal Water Co. for all the water which would probably be needed for a long term of years. Such a contract has since been made and the water supply for the towns referred to may be considered assured.

Perhaps my own interest in this subject is derived partially from some of the earlier associations of my life. In the State of Michigan where I passed, my boyhood there is a tract of country 20 or 30 miles broad, bordering on the river and Lake St. Clair

the Detroit river, and Lake Erie, which is low and heavily wooded, and in wet seasons almost swampy. The settlers of this region had little difficulty in finding water a feet few below the surface, but there were few surface streams, and I have known the farmers to be obliged in very dry seasons to drive their stock several miles daily to water. A belt of country north of this and stretching from Lake Huron in a southwest direction quite across the State to Lake Michigan is covered with the most beautiful little lakes of pure and sparkling water. Lakes which never become stagnant and never dry up.

Farther north again toward the northern part of State, are found extensive pine barrens, where again again there are but few rivers and streams; but I have seen wells driven there from 6 to 10 ft. only to an abundant supply of water. The little lakes I have referred are replenished from the exposed outcroppings of gravel beds, and while they are often linked together so as to constitute the sources of considerable streams, the water from most of these lakes seems to sink away slowly again and to flow underground in broad sheets towards the great lakes. Nearly everywhere in this State water in abundance can be found by driven wells, and I am told that in the regions where the early settlers suffered so much from swamps and mud in winter, and drought in summer, surface drains and tube-wells have created an entirely new condition of things favorable to the farmer.

An objection has been frequently urged against the use of water from these shallow sub-surface deposits that there is danger from pollution or contamination of the water by sewage and surface drainage, the drainage from cemeteries, etc,

While it would obviously be undesirable to establish a driven well plant within the limits of a populous city it may be said that the necessity for so doing is never likely to occur. Moreover the purifying influence of the soil by infiltration is known to be very effective; the well-known processes of sewage disposal by irrigation and downward filtration are based upon this property of the ordinary porous soils.

A microscopic analysis of the effluent water from the irrigation fields of Paris showed that the number of microbes in the sewage was reduced from 20,000 per cubic centimetre to 12 per cubic centimetre, and that the effluent water from the irrigation fields contained fewer microbes than the water supplied to Paris for domestic uses. (See Gray's Report to the City Council of Providence.)

The water being drawn from considerable depths, usually, the purifying effect of the slow downward filtration from the surface would probably be much more complete than is produced by any artificial filtration.

It should be a source of public congratulation that while our rivers and streams must become polluted by a growing population nature furnishes another source of water-supply so abundant and widespread, so pure and so easily procurable.

Explorations and investigations having in view the more thorough study of this underground water-supply deserve, and should receive at the hands of the public, the most earnest appreciation and encouragement.

## The Great Oil "Boom."

Boom, boom, boom,
With thy oil and gas, O land!
And I would that my pen could picture
The fortunes that men have planned.

A well for the smooth-tongued man
As he talks on the street all day!
A well for the man at his desk,
Who counts what the others pay.

And the gaseous boom goes up
And the hundred wells go down,
While the suckers are paying a thousand a foot
For land that's a mile from town.

Boom, boom, boom,
O land, in a thousand spots,
But the fools who are taking their money from banks
Will ne'er get it out of the lots!

—OSMAN C HOOPER in Columbus *News*.

## The Belgian Government Railway 50 Kilo. (110 lb.) Sandberg Rail.

In an article on steel rails which appeared in the April and May (1886) numbers of *Stahl und Eisen*, Mr. C. P. SANDBERG, the well known Swedish engineer, again took up the cudgels against the policy of railway managers, in using such light section of steel rail, and recommended that the railroad engineers of the United States and of continental Europe follow the example of their English brethren in using heavier sections. He referred to the constantly increasing weight of the rolling stock, and the increase in speed, which in turn necessitated a stronger superstructure, which, however, was not to be obtained by use of additional cross-ties, as has been done to some extent, but rather by the substitution of a heavier rail.

For this purpose he submitted the section of a steel rail which we illustrate, weighing about 50 kilo. per lineal meter, or 110 lbs. per yd.

It will be observed that the principle of the joint support is much the same as in the Fisher bridge joint, except that the load is taken on the corners of the fishplates instead of by a base support: At least, the joint approaches much nearer to the Fisher type than is usual here.

The bearing plates are perforated by three holes through which the screw spikes pass. Two of the latter only are used, the third hole being for emergencies.

The use of screw spikes is an innovation on the Belgian Railway and great results are expected from them.

It is believed that the 50 kilo. rail will bear a reduction in weight, from abrasion of fully 15 kilos. before renewal, or about twice the durability of the ordinary rail. Its vertical stiffness is also one-half more.

If proper allowance is made for interest and for the value of the annual abrasion of the rail, the conclusion is reached, that in track where the present rail must be renewed inside of 20 years, the new form of rail is most economical.

Only in "very favorable" cases where rails last 50 years [very favorable indeed, ED.,] the difference in cost would begin to be uneconomical. It is reasonably claimed that a very slight saving in the cost of the maintenance of the road would more than balance this extra cost.

The experiments of the management of the Belgian Government railways with the Goliath rail, as now named may well be watched with interest by American engineers. We gave in our last issue a letter from Mr. SANDBERG bearing upon the rolling of these rails, and we feel confident that ten years from now the rail will not seem so extraordinarily heavy as it does to-day.

*Fig. 1*

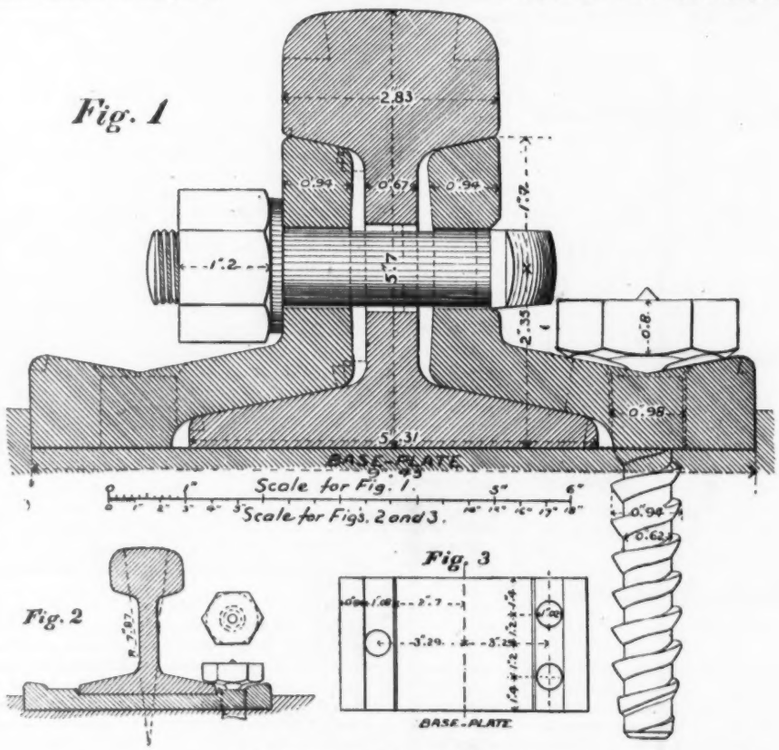



*Fig. 2*




*Fig. 3*




**The Belgian 50 kilo. (110 lb.) Rail.**

The Belgian Government Railway was the first to adopt this section, and have made an arrangement with the Companie J. COCKERILL in Seraing for a quantity of these heavy rails with which to lay a trial stretch of track.

From a description by A. HUBERTI in "*L' Industrie Moderne*" we learn that the rail as used will weigh about 53 kilos. per lineal meter, (the section having been slightly altered by the Belgian engineer FLAMACHE) and is 9 meters (30 ft.) long. There are 12 creosoted oak cross-ties under each rail, the intermediate ones being provided with a bearing plate, while the rail rests directly on the joint ties

The pressure of the rail base upon the bearing plates with the weight actiag vertically is reduced to the very moderate limits of 600 lbs. per sq. in. If the horizontal thrust is taken to equal one-third the weight, the pressure upon the outer rail edge will be 5,700 lbs. per sq. in. The pressures of the present Belgian rails are respectively 1,070 and 13,100 lbs. per sq. in. The pressure of the bearing plate on the cross-ties under a vertical load is 342 lbs. per sq. in. and assuming the horizontal thrust to equal ⅓ of the load we have 711 lbs. per sq. in. instead of the 640 and 1,470 lbs. per sq. in. of the present track. These figures show an increase in resistance of 100 per cent. Special attention has been paid to obtaining a strong joint for this rail consisting of two angle bars. The angle of the bearing surfaces is 1:5. The angle-bars are held together by means of four bolts passing through the rail.

THE, following, from a daily exchange, is a contribution to science which ought to be better known to engineers than, according to the best of our information and belief, it is:

"Would it be supposed that one line of rails on a track is more worn than the other? Such is the case, however. Engineers say that when the track runs north and south, or generally in that direction, the westerly rails are worn out sooner than the easterly set, and that they stretch, or "creep," as they technically express it. The only explanation given of this curious inequality is the supposed greater weight which is constantly thrown on the westerly rail by passing trains owing to the revolution of the earth on its axis from east to west. In other words, the earth's movement tends to tilt the train upon its westerly wheels.'

## The Impediments to Good Practice in Railway Location.

[From the Introduction to the forthcoming Edition (published this week) of "The Economic Theory of the Location of Railways," by A. M. WELLINGTON, C. E.].

*Concluded from page 296.*

To the preceding, which may be called the subjective obstacles to good practice, must be added another and perhaps a greater one. Inasmuch as no one can even know for himself the absolute quality of his own skill in this particular branch of engineering, it is almost a natural corollary that corporations should very uniformly decline to take it for granted, by assuming that there are any measurable differences in qualifications for such work among those who have proved their competency in other branches of engineering. Hence it happens that railway location tends more and more to be entrusted to those to whom it is a mere temporary incident in their professional career, and who consider the work mainly from the constructive standpoint, without much attention to those larger economic questions which it is the purpose of this volume to discuss, and to which, in well-conducted work, the mere constructive details should be wholly subordinate. But as the inexperienced young man can only gauge the importance of various work by the attention which he sees paid to it by his superiors, he is, as it were, pushed by others into an error which it is difficult for him to avoid at best; for he will soon note that the assumption and practice of the world is, that whoever is fit to design the structures of a railway is thereby fitted, without further study or preparation, to design the railway as a whole. In fact, this vicious principle is in very many instances pushed to the absurd extreme of entrusting engineers of inferior capacity with the location of railways, and only seeking for a higher grade of skill when the design of the cheaper man is to be embodied in construction. The error in so doing is the same in kind and in degree as if it were assumed that whoever was fitted to build a house was fitted to design one. The mental qualities and special training needed are much the same in each case, but the two kinds of work are distinct, and skill in one does not argue skill in the other.

Nevertheless, railways must be built, and fortunately there is a bright side as well as a dark side to the picture. There is indeed a pitiable waste resulting from the conditions outlined; such, to mention a simple and readily comprehended example, as has resulted from the location of the entire railway system of the prairie states of the west,—taking it as a whole and neglecting the many individual exceptions,—where the fatal ease with which an airline may be run from almost anywhere to anywhere, by using heavy enough grades, has brought the average train-load lower than in the rugged regions of the east, and caused perhaps a greater percentage of utterly needless waste, and a more discreditable aggregate of thoroughly bad location, than in any other considerable region of the world; and in view of such facts, the distorted pre-eminence given by engineers, and by those who teach them and employ them, to the pettiest details of *how* to build the separate works which make a railway, to the neglect of the larger questions of where to build and when to build, and whether to build them at all, has in it something at once astounding and discouraging. But in a larger view this is in no way surprising. It is but the common result of man's attempts at solving every serious problem which does not admit of exact and positive solution, like a problem in geometry, but contains such indeterminate elements that to solve it perfectly is given only to Omniscience. In all such cases mankind in general shirks the issue, or jumps at a solution in the rudest way, as is seen not only in the work of engineers, but in that of farmers and legislators and merchants, physicians and builders. Compared with the dismal failure which so many men make in every one of these callings, the work of engineers in laying out railways shines by comparison. For after all, the fact, if it be a fact,—as in a rude way it is,—that between waste in construction and waste in operation and waste from inaccessibility to possible patrons, it takes about twice as great expenditure of capital and labor as it need to afford existing transportation facilities—this really means no more than that, instead of realizing 90 per cent. of the advantages which might be gotten from GEORGE STEPHENSON'S invention, as is reasonably possible, only some 75 or 80 per cent. is actually realized. The great world declined to take much interest in such a trifling waste as this, being accustomed to much greater waste in many things, and having something of that large indifference to waste which prevades all nature. Nor would it be worth while here to insist on it for the mere sake of pointing out that it exists, but solely to point out that, as the location of railway is the one department of engineering in which waste on a gigantic scale is possible from probable errors of judgment, and as it is likewise the one department of engineering in which no natural check exists against such errors, it is fitting that engineers should prepare themselves for it with especial care, at least to the extent of acquiring an adequate conception of the number and magnitude of the errors into which they may fall.

Much of the success of any one in any kind of work, and especially in work subject to the peculiar difficulties of that we are considering, depends upon the spirit in which it is undertaken. If it be true, as it unquestionably is, that no one ever attained great success in any walk of life—or certainly in no intellectual calling—who found no other nor higher pleasure in doing that well which was given him to do than in the money or the glory which he might get from doing it, it is certainly much more true in a calling where those ordinary stimuli work very imperfectly or not at all, and in which one is often called upon to do the direct contrary of what will win him credit from the thoughtless and superficial. The desire to do good work for its own sake is then the only real guarantee that good work will be done; for although a kindly Providence has given the latent power to do bad work of this kind to every human being with a tolerably observant eye and intelligence enough to lay up bricks, most assuredly the power to do good work will not come by nature. The author, therefore, feels that he need make no apology to those young men who may honor him by studying this volume, for offering them one page at least of true wisdom, in the stately periods of one of the greatest thinkers of our or any age; which he does in the belief that they will find its study more profitable than that of many pages in this or any other text-book, since, if they have studied it to some purpose, they are at least assured the most permanently gratifying of all success—the consciousness of having done one's best:

"I look on that man as happy, who, when there is a question of success, looks into his work for a reply—not into the market, not into opinion, not into patronage. In every variety of human employment, in the mechanical and in the fine arts, in navigation, in farming, in legislating, there are among the numbers who do their work perfunctorily, as we say, or just to pass, and as badly as they dare,—there are the workingmen, on whom the burden of the business falls,—those who love work, and love to see it rightly done, who finish their task for its own sake; and the state and the world is happy that has the most of such finishers. The world will always do justice at last to such finishers: it cannot otherwise. He who has acquired the ability may wait securely the occasion of making it felt and appreciated, and know that it will not loiter. Men talk as if victory were something fortunate. Work is victory. Wherever work is done, victory is obtained. There is no chance, and no blanks. You want but one verdict: if you have your own, you are secure of the rest. And yet, if witnesses are wanted, witnesses are near. There was never a man born so wise or good, but one or more companions came into the world with him, who delight in his faculty and report it. I cannot see without awe, that no man thinks alone, and no man acts alone; but the divine assessors who come up with him into life, now under one disguise, now under another, like a police in citizens clothes, walk with him, step for step, through the kingdom of time.

"What is vulgar, and the essence of all vulgarity, but the avarice of reward? 'Tis the difference of artisan and artist, of talent and genius, of sinner and saint. The man whose eyes are nailed, not on the nature of his act, but on the wages,—whether it be money, or office, or fame,—is almost equally low."*

The true moral to be drawn from such glittering generalities is not that if a man does not succeed the world is not doing justice to him: for the chances are a hundred to one that it is meting him out exact and equal justice, and that unless he wipes out delusion from his mind and sets about correcting his deficiencies, it will continue to do so in the same way: nor is it that a man should neglect that reasonable care for his own welfare which is every man's duty, nor that he should submit to imposition, nor continue very often, for very long, to render something for nothing. In this utilitarian age there is little danger that it will be so interpreted. But the author has seen—or thinks he has seen—so many young men doing permanent injury to their own future by letting $150 a month fill up the whole arc of their horizon, that he has seized his chance, while he has them foul, to inflict a little advice. He grants it is against the laws of the game, and stops.

*Ralph Waldo Emerson: "Essay on Worship."

## The New Method of Dimensioning.

BY ALFRED D. OTTEWELL, C. E.

II.

Formulæ (*A*) and (*B*) are intended to apply also to steel for railroad bridges; in which case for tension members (links or rods),

$$u = 7{,}000. \qquad t = 21{,}000.$$

thus allowing 40 per cent. excess for steel over iron and for members in tension or compression (plates or shapes),

$$u = 6{,}000. \qquad t = 18{,}000.$$

allowing in this case 33⅓ per cent. excess for steel over iron. The steel to be to the following specification:

All steel to be tough, uniform in quality throughout, free from cracks and injurious flaws, and shall have a workmanlike finish. Test pieces cut from full size bars, with area of cross section not less than ¼ sq. in., must be capable of sustaining an ultimate stress of not less than 65,000 or not over 75,000 lbs. per sq. in., and shall have an elastic limit of not less than 40,000 lbs. per sq. in. The test pieces shall show an elongation of at least 20 per cent. in 8 ins., measured after breaking and a reduction at the point of fracture of at least 40 per cent.

The permissible stress $a$ for members in compression to be reduced, in proportion to the ratio of the length to the least radius of gyration of the section, by the formulæ (*E*), (*F*), or (*G*) proposed below; which formulæ are also proposed to be used for wrought-iron.

For comparison the following table is given showing the values of $a$ for steel for different values of $\frac{min.\ B}{max.\ B}$ according to the authorities named:

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| $\frac{Min.\ B}{Max.\ B}$ | Du Bois. | Keystone Bridge Company. | Formula *A* | "Standard." | Approx. corresponding span. | Per cent. difference between weight due to cols. 4 and 5. |
| .449 | 15960 | 15200 | 13590 | 14000 | 305.5 | + 5.4 |
| .459 | 16100 | 15300 | 13630 | 14000 | 320 | + 4.2 |
| .494 | 16600 | 15700 | 13920 | 14000 | 374 | + 0.6 |
| .507 | 16780 | 15920 | 14100 | 14000 | 400 | − 0.6 |
| .518 | 16920 | 15950 | 14250 | 14000 | 420 | − 1.7 |
| .537 | 17200 | 16120 | 14520 | 14000 | 450 | − 3.6 |
| .54 | 17250 | 16170 | 14560 | 14000 | 475 | − 3.9 |
| .561 | 17550 | 16400 | 14850 | 14000 | 516 | − 5.8 |

Col. 5, gives the unit strains required by the usual or "standard" specification of 14,000 lbs. per sq. in.

Col. 6, gives the approximate spans in feet in which the stress due to dead load would be to the stresses due to dead and live load as the given value of $\frac{min.\ B}{max.\ B}$. The live load consisting, as before, of two "typical" consolidation engines followed by a train weighing 3,000 pounds per foot of track. This column being obtained from a series of calculated weights of single track through steel* bridges given in the before mentioned paper read by Mr. GEO. H. PEGRAM before the American Society of Civil Engineers.

Col. 7, gives the approximate percentage of weight required by formula (*A*) greater than or less than the weight required by the "standard" specification, (±) 4 meaning that the bridge in column 4 would be 4 per cent. (heavier, lighter) than the bridge of column 5.

It will be seen from this table that the weight of a bridge to formula (*A*) differs very little from the

* "In these spans the floor beams, stringers, lateral struts, counters and small lateral rods are made of iron."

weight of a similar bridge to the usual or "standard" specification.

Referring to formula ($A$) and formulæ claiming to be based on the experiments of WÖHLER and SPANGENBURG such as the formulæ of LARNHARDT, WEYRAUCH, CAIN and others; it has been asserted that WÖHLER's experiments do not justify the superstructure that is being erected upon them. Such an assertion, however, does not apply to formula ($A$), since this formula was derived without any reference whatever to the experiments of WÖHLER and SPANGENBURG, and up to this point the writer of this article has purposely omitted any reference to these experimenters, lest he should be misunderstood. Formula ($A$) was derived from the three following practical observations:

1. The injurious effect of a live load on any member of a bridge is much greater than the injurious effect of a dead load of the same amount.

2. If the member is one of the wrought-iron tension bars of a railroad bridge, the iron being to standard specification, the allowable unit stress, $t$, for a dead load should be 15,000 lbs. per sq. in.

3. If however the load is entirely a live load, and always produces the same kind of stress, tension or compression, the allowable unit stress, before considering it as a column if in compression, should be 5,000 lbs. per sq. in.

From these three observations formula ($A$) was derived in the following manner. Let $max.\ B = M$ = the greatest stress upon the member, whether of tension or compression.

$Min.\ B = m$ = the least stress of the same kind.

$a$ = safe working stress under assumed condition of loading.

Then the stress produced by the dead part of the load is $min.\ B = m$, and the additional stress produced by the live part of the load is $max.\ B - min.\ B. = M - m$.

| | | | | |
|---|---|---|---|---|
| Now if the additional stress produced by the live part of the load $(M - m)$ | is equal to | the stress produced by the dead part of the load $(m)$ | then the permissable unit stress | $a = \frac{15{,}000 + 5{,}000}{1 + 1} = 10{,}000$ lbs. |
| Also, | | | | |
| " " | is double | " " | " | $a = \frac{15{,}000 + 2 \times 5{,}000}{2 + 1} = 8{,}333$ lbs. |
| Also | | | | |
| | is treble | " " | " | $a = \frac{15\,000 + 3 \times 5{,}000}{3 + 1} = 7{,}500$ lbs. |

or in general,

$$a = \frac{t + \frac{M - m}{m}\,u}{\frac{M - m}{m} + 1} = u\left(1 + 2\,\frac{min.\ B}{max.\ B}\right)$$

since $M = max.\ B$, $m = min.\ B$, $t = 3u$, and in the case considered $u = 5{,}000$.

By changing the values of $u$, the formula has been applied to other qualities of iron and to steel.

Without assuming, therefore, anything more than three facts agreed on by practical engineers' formula ($A$), has been deduced; and the fact that it takes the same form as formulæ deduced from the experiments of WÖHLER and SPANGENBURG simply adds weight to its value and shows these experiments to be in harmony with general experience.

It will be "observed from the first of the above three practical observations, upon which formula ($A$) is based, that the formula applies to members in compression as well as to members in tension. The writer, therefore, cannot agree with those who adopt modifications of the formulæ of LARNHARDT and WEZYRAUCH for members in tension alone; for to assert that a member under compression is not fatigued more by the application of any number of repetitions of load, with impact, than by the application of a single static load seems to be wholly at variance with practical experience and observation. If such an assertion were true, we should have long struts with the same permissible unit stress as for long ties, other things being equal, thus allowing nothing for the fact that a strut is in unstable, whilst a tie is in stable equilibrium.

It now remains to consider the application of the proposed formulæ to members in compression.

In a discussion on a paper read, June 25, 1885, before the American Society of Civil Engineers, by Mr. JOSEPH M. WILSON, on "Specification for Strength of Iron Bridges," Mr. EDWIN THACHER pointed out the fact, with reference to the strength of wrought-iron struts, that a straight line could be made to represent graphically "more nearly than any of the proposed curved line," the average temporary strength of wrought-iron flat ended struts. Such a straight line is the line on diagram II, starting at 45,000 at $\frac{l}{r} = O$ and ending at $O$ at $\frac{l}{r} = 280$. A similar line starting at 45,000 at $\frac{l}{r} = O$, and ending at $O$ at about $\frac{l}{r} = 220$, Mr. THACHER pointed out, represents "quite as nearly as any of the proposed curved lines," the average temporary strength of wrought-iron pin-ended struts. For struts of steel to the specification given above, we would propose a line starting at 54,000 at $\frac{l}{r} = O$, and ending at $O$ at $\frac{l}{r} = 280$ as representing the temporary strength of flat-ended struts, and for pin-ended struts a line starting at 54,000 at $\frac{l}{r} = O$, and ending at $O$ at $\frac{l}{r} = 220$ as representing the temporary strength.

For the purpose of comparison the lines marked "hard steel," "mild steel" and "iron" are given. These lines are based upon several hundred experiments described in two valuable papers, entitled "experiments on the Strength of Wrought-Iron Struts" and "The Strength and Elasticity of Structural Steel," read by Mr. JAS. CHRISTIE before the American Society of Civil Engineers.

If then the straight lines 54,000 to 280, and 45,000 to 280, represents the temporary strength of flat ended struts of steel and wrought-iron respectively, to secure a uniform "factor of safety" the lines representing the safe working strength should from similarity of triangles also converge to the point 280. It is for this reason that the lines from 18,000 to 13,500, 6,000 and 4,500 converge to the points 280, 250 and 220 for flat-ended struts, one-flat-and-one-pin ended struts, and pin ended struts respectively.

The lines radiating from 18,000 and 6,000 are the upper and lower limits respectively given by formula ($A$) for steel, whilst the lines radiating from 13,500 and 4,500 are the upper and lower limit respectively given by the same formula for iron.

It will be observed from the dotted lines of diagram II that the straight line 63,000 to 280 corresponds very closely, between practical limits, with the dotted curved line, which curved line is assumed to represent steel of about .25 carbon. Should such steel be employed for the compression members the above specification would be altered for those members to: Ultimate strength 75,000 to 85,000 lbs. per sq. in., Limit of Elasticity 45,000 lbs. per sq. in., with 18 per cent. elongation in 8 ins. and 35 per cent. reduction at point of fracture. The values of $u$ and $t$ would then become the same as for tension members, viz.:

$$u = 7{,}000. \qquad t = 21{,}000.$$

Whether such steel is suitable and preferable for railroad bridges are to-day two of the vexed questions among experts in bridge building, and can only be decided by future experience. For the present the writer prefers the single specification first given, since if it errs, it errs on the side of safety. The question may reasonably be asked those who adopt the former specification for members in tension, and the latter specification for members in compression. "If the latter specification is suitable and preferable for members in compression why is it not suitable and preferable for members in tension?"

The following are the equations of the straight lines of diagram II and are the formula proposed for struts whether of wrought-iron or steel.

For both ends flat

$$b = a\left(1 - \frac{l}{280\ r}\right) \qquad (\quad)$$

For one end hinged

$$b = a\left(1 - \frac{l}{250\ r}\right) \qquad (F).$$

For both ends hinged

$$b = a\left(1 - \frac{l}{220\ r}\right) \qquad G).$$

where,

$a$ = permissible strength previously found.

$b$ = allowable working stress per sq. in.

Value of Length Divided by Least Radius of Gyration.

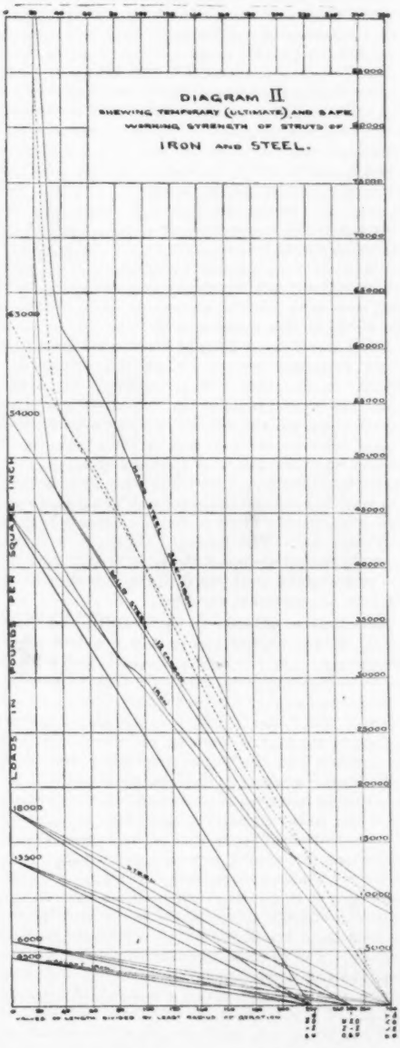



Diagram of Strains on Compression Members.

$l$ = length of piece in inches, center to center of connections.

$r$ = least radius of gyration of the section in inches.

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A NEW variety of pressed brick, made of ashes and cinders, is now being manufactured in San Francisco. The *Examiner*, of that city says: "The result is a brick of unusual solidity, handsome in appearance, of a most durable character and made entirely without burning or baking. All manner of experiments have been tried with the bricks in the way of subjecting them alternately to intense cold and heat, but without any injurious effect. The best quality have even been boiled for hours, without cracking or showing any signs of dissolving." We tell the tale as 'twas told to us. The little question of what cementing material is used is not stated.

## Details of Joint and Broken Hangers, Bussey Bridge.

The accompanying views have been prepared to show what foundation there is for the claims which have been advanced, that the hangers whose failure caused so terrible a disaster were so covered up, in the words of one expert who testified as to the hearing, "as to be forever beyond the reach of inspection." While in a sense it is hardly worth while to discuss ancient history, yet harm is always done when facts are misunderstood, and "inspection" will be little more than a farce, when any considerable number of engineers who claim to understand such matters are ready to say deliberately that such a joint as this is difficult of inspection, and give up the attempt in advance. It seems the more important to show the exact facts in the matter, because this alleged difficulty, or impossibility of inspection ran all through the testimony at the hearing,

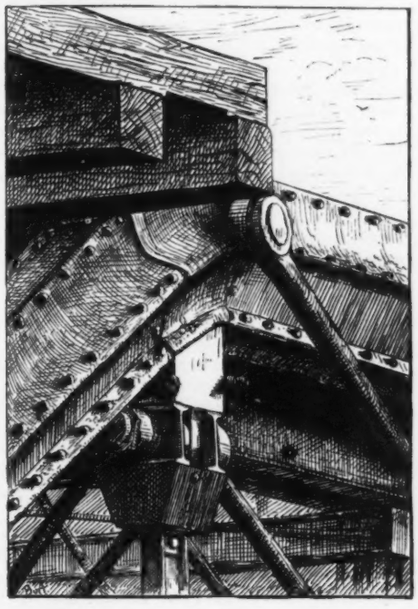

Fig. 1. Perspective View of Joint.

and even appears in the findings of the Commission. The Commission do not state directly that inspection was impossible, but they state on page 9: "These hangers were so encased in the joint-block, and were so placed with reference to the I-beams, that only a small portion of the lower side of the lower loop *could be seen*" while on page 17 they say "It is a defect in any bridge, if a vital part, no matter what excess of strength it may have, is unnecessarily covered up *so that it cannot be inspected.*" This was literally true of the parts which did *not* break, the upper ends of the hangers, but of the lower ends of the hangers, which did break, it is not true in any sense.

This becomes clear by examining the drawings. Fig. 1 is a photographic enlargement of the details of the joint, taken from the photograph from which our general view of the bridge was prepared in our issue of March 19, following the disaster. It will be observed that it differs quite a little in some minor details from Figs. 2 and 3, which are the best drawings we have been able to obtain, made since the disaster, and probably the best which exist. They are materially more correct than those which appear on page 9 of the Commission report, which are wrong in several details.

Fig. 1 shows the joint as it would appear to an observer from the street. With an ordinary long ladder he could readily reach it from the street. It will be seen that the excentric form of the hangers was discoverable, even in a distant view. In Fig. 3, the locality of the worst old break is shown to scale, which was in the hanger having its back or straight part toward the outside. We will call this hanger *A*, and the other *B*. This hanger only hung together by a thread at the back side, where there was no strain. From the nature of the break, therefore, it must have opened quite considerably at the front. The appearance of the break made it quite certain that it was one of many years standing, and in our issue of March 26 we showed the strong theoretical grounds for believing that the break must have started within a few weeks after the structure was erected.

Hanger *B*, had its curved side to the front, and thus left an opening around which it was possible to reach with the hand, between the I-beams, and readily touch with the fingers the concave inner side of hanger *A*, at the point where the fibers should have been most strained, and where the break actually was. This is clear enough from the drawings that we publish, if we remember that an average finger is 3 to 3½ in. long, but to make assurance doubly sure, we have caused a full sized wooden model to be made of the joint complete, including the ends of the two I-beams, lower pin, hangers in position (of their exact actual form as traced off on a piece of paper from the hangers

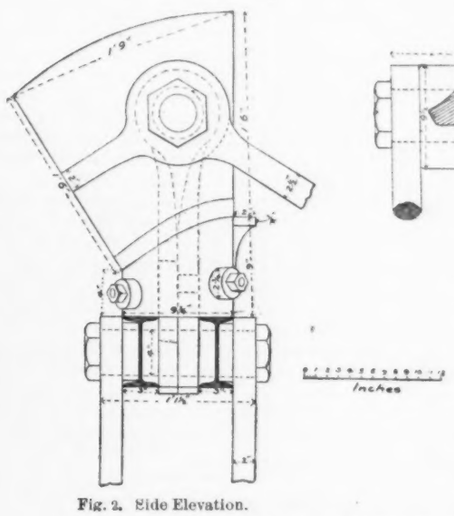

Fig. 2. Side Elevation.

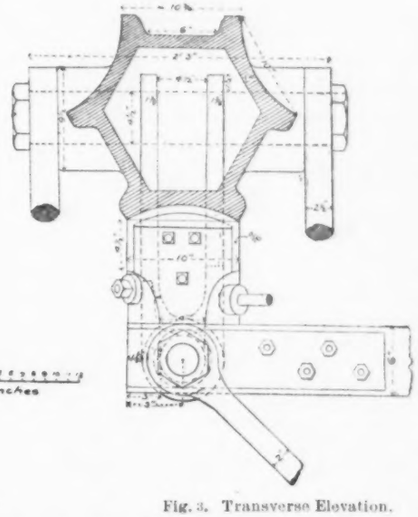

Fig. 3. Transverse Elevation.

Details of Joint and Broken Hangers; Bussey Bridge.

themselves) with the old breaks notched in them and lower part of cast-iron box in place;—and we find that the inside corner of the old crack *could be reached with perfect ease by the thumb, with half an inch to spare*, as, of course, by the fingers also. Moreover, with a bulls-eye light, or even a candle or match, the locality of the crack and a considerable distance above it was very readily visible from the outside. Again, with a slim steel scraper, nearly the whole length of the hangers, could be explored from the outside.

It is hardly necessary to say that in inspecting bridges of any size much more serious difficulties than these frequently arise in getting access to various parts which need examination. It would therefore be most unfortunate to have the idea get abroad among the rising generation of engineers that such trivial obstacles to inspection as these were in any sense an excuse for non-inspection. Even had there been nothing visible in the form of the hangers to create suspicion, this would not be so. They should have been inspected for external defects, so far as it was possible to do so, as a mere matter of form. But inasmuch as their highly unmechanical form was clearly visible from the outside, and would immediately create suspicion of failure in one particular and easily accessible spot where failure had actually occurred, there is still less excuse for it. Therefore, the fault with the bridge was not the single one of ten years' standing, that certain parts could not be inspected, but in addition the continuing fault that the bridge never was inspected, for if it had been its broken parts could have been at once discovered, at any time.

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AT the end of 1886 France had 19,510 miles of railroad in operation; the total receipts for the year were $201,527,445, about $4,200,000 less than in 1885; no statement is made of number of passengers or amount of freight.

## The London Sewage-Sludge-Ships.

The *Builder* describes the sludge-ships for removing London sewage, the design being approved by Sir FREDERICK BRAMWELL and Sir JOSEPH BAZALGETTE. The Barrow Shipbuilding Co. is now building the first one at a contract price of $78,750. This ship will have a load displacement of 1870 tons and will carry 1,000 tons of sludge. The length between perpendiculars will be 230 ft.; beam 38 ft. and depth of hull 14 ft. 6 in.; when loaded the ship will draw 9 ft. 9 in. forward, and 10 ft. 1 in. aft. The material principally used, is steel with stem and stern-post of iron and steel deck.

The engines are of the triple expansion type, in two sets, and drive twin screws; a speed of 10 knots per hour is expected. The sludge is transmitted from the precipitation works in iron-pipes, and is loaded into four large water-tight compartments, ranged two abreast in the ship's hull and occupying a length of 122 ft. The sides of these compartments slope to the center, and in each compartment are two 18 in. outlet valves for discharging the cargo, the valves operated by a screw-rod from the deck above. As the sludge to be produced at the two outfalls will amount to 3,000 tons per day when in full operation, 3 ships will be required; and to avoid undue pollution of the sea, 10 miles beyond the Nore, this quantity of sludge will be discharged over 30 miles of a sea course. Mr. DIBDIN figures, that as this sludge will contain about 150 tons of organic matter, the track of the ships will not be polluted to a greater extent than about 16 grs. of organic matter per gallon of sea-water.

## Increasing the Strength of Portland Cement.

The *Thon Industrié Zeitung* gives the following as a recently patented method for hastening the setting and increasing the strength of Portland cement:

Take 100 parts by weight of finely powdered bauxite, or in lack of this, 100 parts of powdered refractory argillaceous earth, and mix with it 50 parts of sulphuric acid in such manner as to make a solid cake. After 24 hour's time put the mass in a furnace until it become hard and of an ash-tint. This is then finely pulverized and mixed with boiling water so as to form a liquid paste; add to this a solution of soda so as to render the liquid alcaline and separate by decanting the water from the precipitate. The latter is then carefully gathered up, washed in distilled water, dried, pulverized and sieved.

The hydrate of alumina, which is uniformly present, provokes the rapid setting of cement, and the soluable silicate increases its strength. To transform a slow into a quick-setting cement, mix with it from ½ to 1 per cent. of the powder. In making moulded objects, the proportion ought to be from 2 to 4 per cent.

# ENGINEERING NEWS

VOL. XVII. Saturday, May 21, 1887.

D. McN. STAUFFER. A. M. WELLINGTON. EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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THE *Genie Civil*, of April 30, reproduces our general view of the Bussey bridge and the cut of the broken parts of the hangers, but fails to give this journal any credit therefor. The prime delinquent, most probably, is one "H. D. WOODS, *Ingenieur des Arts et Manufactures, à Boston (Mass.),*" who writes the article and presumably furnished the material for illustration. But as *Le Genie Civil* is among our most valued foreign exchanges and is frequently quoted in this journal, we would suggest to our contemporary a little more careful revision of its correspondence. Mr. WOODS is apparently artful in other directions than in those indicated in his title as above set forth.

WE are pleased to learn that the new Boston-New York train lighted with electricity and heated by steam, is paying well. A gain of 30 or more passengers per day, has resulted, if we are correctly informed. As a consequence, there is great activity in the direction of electric lighting of cars, and it is now needless to say, in steam heating likewise. Both those great improvements seem destined to rapidly come into general use, for the very good reason that they will pay as an attraction to travel as well as serve to relieve a road from the very disagreeable position in which it is likely to be placed should it burn up a car-load of passengers next winter for lack of them, as some road is likely to do in the ordinary course of events.

MR. W. F. MATTES recently read a paper before the American Institute of Mining Engineers, which has had the result of provoking not a little discussion, at least, although it did not bring out many new facts of especial interest. We agree with the *Railroad and Engineering Journal* that the rail section recommended by Mr. MATTES was in several respects objectionable, which was a chief reason why we did not republish the paper, and we are also gratified to find that we are able to agree almost exactly as to the objections raised to the section, which are much the same as those which we raised to the similar Lehigh Valley section in our issue of Feb. 26, 1887, although reached in a different way. These objections are, first, that the side of a well-shaped head should slope inward instead of flaring outward, and secondly, that the metal underneath required by a very flat fishing angle is practically thrown away, as respects the strength and life of the rail, and only useful for making a better fish-plate joint. That an angle of 30° or 33° will do equally well for the bearing surfaces of an angle-bar joint, however, as our contemporary maintains, is a surprising and we apprehend wholly untenable position. No doubt plenty of rail-sections which have had such angles can be found. Rail sections can be found which have had almost any peculiarity; but a sa fishing angle of 33° increases the pressure normal to the surfaces by nearly $\frac{1}{8}$ [$L$ (sec. $f-1$)] and produces a lateral resultant of nearly $\frac{3}{4}$ $L$ ($L \tan f$) we apprehend that no very large number of engineers in this country will be ready to try so rash an experiment.

A much wiser thing for engineers to do will be to muse upon this statement of our contemporary: "It is generally agreed by experienced railroad men, that if the lower edge of a flange impinges against the rail, the flange is liable to mount the rail." It is indeed; as also that if the middle point of the flange impinges against the side of the rail, there is something like half the danger of the same result. Yet our contemporary, whenever it shows a rail-section, continues to show one in which the flange is chronically in that position from the corner of the rail having been cut off so that the flange may "bear" (*i. e. rub*) against it from the beginning. This form of rail has been repeatedly objected to, for reasons given at length, but it has never been defended, perhaps for the very good reason that it cannot be defended. But as it claimed on good *prima facie* grounds, to say the least, that this rounding of the corner is in reality seriously detrimental both to the life and safety of the rail, it is unfortunate that those who have taken a position in favor of it, should not either abandon their position, or show in a definite technical way that the objections which have been made to it are not well founded.

THE water-meter test now going on in Boston is evidently not wholly satisfactory to the competing firms, and one firm at least has withdrawn from the contest. The bone of contention is whether the test is, or is not a public one as originally announced by the Commission. The meter-makers argue with very considerable justice, that a public test properly includes the opportunity to study at short range the working of rival meters as well as their own. This privilege is flatly denied them, and hence their discontent.

As before mentioned in these columns, the past history of the testing and adoption of water-meters in Boston is so very peculiar and more than suspicious that the present commission owe it to themselves and to the good name of the city they represent to omit no measure that would make this trial what it purports to be, a fair and impartial test of the relative merits and demerits of some thirty-three different types of water-meters. Honestly and intelligently carried out such a test should be extremely valuable to water-purveyors; but nothing can be gained by throwing obstructions in the way of a fair test, and any such obstruction, no matter how innocently intended, simply strengthens the charges, already made very prominently, that the whole test is a sham and was so intended from the beginning.

The Commissioners seem to object to the possible inconvenience of having every one of the thirty-three competitors inside the rail at one time. But as they are supposed to be paid for any inconvenience, and as their personal comfort is of very little importance compared with the value of an honest and impartial test, their objection is not a valid one. The commissioners can as little afford the display of any disinclination for the greatest publicity and most exacting tests, as could a competing maker afford to "monkey" in any way with a rival's meter, as some of the commissioners seem to fear. The whole affair is in bad odor anyhow, and the present behavior of the Commission is only making this odor more pronounced.

WE learn that the prospects for wider use of interlocking signals this year are very good. The Boston & Albany has been one of the foremost in availing itself of them, and are now outfitting large yards at Worcester and Springfield. In all parts of the country the tendency to extend the use of these automatic devices is said to be decided.

MASSACHUSETTS, we believe, is now the only State in which any one road which crosses another at grade can put in interlocking signals without the consent of the other line, and so dispense with a crossing stop. The road which does not consent to bear its half of the expense is obliged to stop its trains as before, but on the other hand, the road which first acts is obliged to bear the whole expense of the apparatus, for the time being at least.

This law was passed in 1885, we believe, previously to which, it was solely a matter of agreement whether such interlocking apparatus was put in or not, as it is now in all the six or eight other States which have any laws at all with reference to interlocking at crossings. The list of these States has been increased within the past two months by the passage of a law in Wisconsin on the subject, and a strong effort is being made to pass such a law in Illinois. As there is nothing to be said against such a law and everything to be said in its favor, it ought not to require much "effort"; but the ways of legislators are past finding out or counting on.

The Boston & Albany, if we are correctly informed, have already taken advantage of the new Massachusetts law to put in interlocking signals at the Westfield and Palmer crossings.

THE question of whether or not there has been or could have been proper inspection of a structure which has failed is always a delicate one; for there is a certain superhuman grade of vigilance which *might* avert an immense class of disasters and yet which cannot reasonably be looked for nor demanded from merely human men. For example, the rail whose breaking caused the Woodstock's wreck was alleged, and we have no doubt with truth, to have been constantly inspected by track-walkers with all the usual care and frequency and to have had no visible defects to excite a track-walker's suspicion, yet we feel as little doubt that had a lot of experienced trackmen had their attention especially attracted to that one rail and gone over it with a microscope, they would have had no great difficulty in discovering somewhere clear surface indications of the hidden defects. To ensure as much as possible of this extreme vigilance the common law wisely holds the common carrier to a very strict responsibility, so that he is in effect a plenary insurer of the property and persons he carries. It does not follow from this, however, that he is, humanly speaking, at fault for every disaster he has to pay for. The Central Vermont was grossly in fault for not having the ends of its bridges protected with a re-railing safety-guards, as are also most of the roads in this country today, but it was not in fault for its defective rail, in any reprehensible sense, even if it was *possible* to have discoverd that the rail was imperfect at any time.

But from the very fact that there is this dif-

ficulty in fixing the precise line where negligence ends and misfortune begins, it is the more important to enforce and insist upon proper inspection whenever it is clearly possible, and we therefore regard it as something of a public misfortune that there should have been so much talk around Boston of the "difficulty of inspecting" the Bussey bridge, which has even gone so far that one of the gentlemen who testified as experts has repeatedly declared that the defective parts were "forever beyond the reach of inspection." The bridge was not difficult to inspect, in any sense of the word whatever, as respects the parts which failed. On the contrary, it was particularly easy to inspect, both because there were circumstances clearly visible from the ground to direct suspicion to the locality of the actual break, and because those localities were accessible to the hand and to the eyesight, while standing erect upon two feet in a comfortable and safe position. This we have thought it well to show more fully elsewhere, after doing what no one else seems to have taken the trouble to do, making a full-sized model of all the parts concerned, to find out exactly how the case stood. Those who have ever had occasion to do much inspecting, and know how frequently a man has occasion to regret that he is not a monkey and provided with a prehensile tail, so that he may be able to turn himself upside down and inside out to get at otherwise unapproachable points, will smile at the notion that there was any serious difficulty in examining all the vital portions of the hangers whose failure caused the wreck. Let no young man, or old, run away with the notion that an "inspection" would be anything more or better than a conspicuous display of incapacity which was made with so little thoroughness as to pass such obstacles as these as insurmountable, or even as in any sense serious.

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IN connection with the recent reduction of the gas rates in Brooklyn to $1.60 per M., a price which still contrasts unfavorably with the New York City rate of $1.25, the New York *Times* repeats some interesting data of gas rates in England. Three companies supply London with gas. In 1884 the ruling price was 65 cents per M., and the companies paid dividends of about 12 per cent. The suburbs of the city are supplied by twelve smaller companies, and the average price charged by the fifteen companies at present is only 75½ cents. As the average cost of manufacture and distribution is only 45¾ cents per M., the sum of 29¾ cents remains for profit. These figures may indeed make people envious who have to pay gas bills on this side of the water, but the returns from the British provincial cities contrast even more forcibly with the similar rates in this country. Of nineteen companies doing business in Liverpool, Leeds, Sheffield, Birmingham, Manchester, and Nottingham, the average rate charged consumers was 58½ cents per M.; the average cost of manufacture was 37½ cents, leaving 20¾ cents profit.

Another point of contrast lies in the amount of capital stock. The capital of the South Metropolitan Company of London in 1884 was only $11,401,800, although the company produced and distributed 10 per cent. more gas than was sold in the following year by the Consolidated Company of this city, whose capital was $39,078,000. The London company required a capital of only $2.69 per M., while the New York company had $10.23, more than $20,000,000 of which New York company's capital was water.

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THE daily increasing press of travel on the New York elevated roads almost imperatively demands a decrease in the headway between trains as the only measure of immediate relief. This means more ample terminal facilities in Battery Park for handling trains, and hence the tears and protests of the Park Commissioners against what they term "another grab" of city property.

While we do not approve of the free occupation of streets or parks by future elevated structures, and would advocate as a rule the purchase of real estate and the piercing of the blocks for any extension of the present elevated system, we think, with many other travelers on these roads, that some such relief as suggested at Battery Park is necessary. We do not know exactly the details of the proposed increase in shifting room, but can not see why the street and not the Park should be made to accommodate the required additional structure. Unless absolutely necessary the Battery Park is altogether too ornate and useful a feature in the lower end of New York to be further curtailed by iron trestles.

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### Bags vs: Barrels for Cement.

It is probable that there will be manufactured and consumed this year in public works in the United States about 5,000,000 barrels of natural hydraulic cement, worth in the market an average price of $1.00 per barrel, or representing a sum of $5,000,000. It is also safe to assume that three fourths of this product will be packed and marketed in barrels costing about 30 cts. each; a package value alone of $1,125,000, which represents just so much money wasted in the destruction of the barrels as soon as the contents are used.

In contrast to this wasteful procedure, in dealing with a product that very generally goes directly from the mill to the consumer, we have the practice of England and the Continent in shipping cement under similar conditions in bags instead of barrels. The advantages of the bag package are—some economy in space in transportation, and the very material economy in the difference of cost of the package; as the bag can be provided for about 5 cts., and when empty can either be sold for other uses, utilized by the contractor in his own works, or redeemed by the cement maker at a price that amounts to a sensible reduction upon the cost of cement when the quantity is considered. Bags can be shipped back, or used for a number of purposes; barrels can only be broken up and burned under the boilers as a substitute for very much cheaper fuel.

The prejudice against bags in our own country is mainly confined to the Eastern and Middle sections, which unfortunately are the greatest consumers of cement. In the West, in Chicago, St. Louis, Cincinnati, St. Paul, Omaha, Kansas City and other large towns, cement is now largely delivered in bags, and as far as the quality of the cement is concerned, improvement rather than damage is noted as resulting from this more economical practice.

The great objection made to bags is that they are not tight and permit a certain air exposure; and yet our experts in cement say that the best foreign and domestic cements require a certain amount of exposure to the air to secure maximum results. Nearly every cement contains a greater or less amount of free lime, and on the other side of the ocean large sums of money are expended in getting rid of this objectionable ingredient. A year ago we watched with very considerable interest the handling of the cement intended for use in the Vyrnwy Dam, for the extension of the Liverpool water-works, and one of the most important engineering structures of this character now under construction. The cement used was all delivered in bags, and moreover was hauled some 12 miles over mountain roads after leaving the railway terminus. Although of the best attainable quality primarily this cement was submitted to further air exposure for six days before use. This manipulation, deemed so essential on this important work, was accomplished as follows:

Bins were arranged in a tier of six floors, one above the other, each of these bins containing a full supply of cement for one day's use; these floors were made with overlapping slats that could be turned from the outside of the bins. Each morning, with the lower bin empty and commencing at the bottom, these slats were turned and the contents of each bin successively dumped into the one below; the contents of the bottom bin as thus provided was used in that day's work and the upper bin of all was refilled from the bags with a fresh charge of cement. By this means all cement used on the work had first been exposed to the air in comparatively thin layers for six days and had been handled six separate times; the elimination of the free lime and the prevention of the evil action of this ingredient in masonry intended to be water-tight was the sole purposes of this somewhat tedious and expensive process. Foreign specifications require "a well seasoned cement," while we for some reason seem to seek "a fresh-ground cement," which, as shown above, would be excluded from any important public work abroad.

For these reasons it would seem that there is no valid objection to the use of bags for the carriage of cement and many good reasons in favor of so doing. Foreign practice evidently deems a much more extended air-exposure than that resulting from its transport in bags as assential and improving. As to storage of cement before use, the same sheds now used for storing barrels would store the bags as well; and no good cement will sustain any practical injury by being exposed in bags to a passing shower, provided it is to be used within a short time thereafter; some dampness may slightly retard the setting qualities, but the ultimate strength is in no manner injuriously effected. For a manufacturer to admit that his product will not stand so slight an exposure, should be fatal to his claims for merit.

This is a question that from an economical standpoint alone is well worth careful study by our eastern engineers and architects; and if a greater exposure to air than can be secured in its passage from the mill to the mortar-bed in tight casks is really beneficial, as foreign practice would seem to prove, then the barreling of cement is not only wasteful in money, but also wasteful in good structural effect.

When it comes to a long sea-voyage and the risks attending such transportation, the tight cask is well enough; but for ordinary home consumption, the European specification of "well seasoned and packed in *suitable packages*," would certainly be more in accordance with common sense and good practice. The only reasonable explanation for packing in barrels the cement intended for home consumption, that we can see, lies in the tradition that the first hydraulic cement used in this country came across the ocean in similar packages; then when we began to manufacture cement ourselves, the precedent thus established was followed. The fact that something else in really cheaper and better, does not yet seem to be properly appreciated, as we regard the question of bags *vs.* barrels. But if cement manufacturers and cement consumers in this country can advance any good reasons why our practice in this direction, should differ so materially from that of England and the Continent, we would like to hear from them in the interest of all concerned. The subject is one well worth discussing.

### Patents and Patent Law.

The patent laws are, on the whole, of immense benefit to the country. It is rare indeed for a man to derive greater profits under them than he is fairly entitled to from the value of his invention, while he often gets much less. On mere grounds of expediency, apart from the claims of justice, the laws are justified by the fact that they warrant men in devoting much trouble and expense to the introduction of new devices, which they could not and would not do, if they were not protected against the danger that others would step in at the eleventh hour, and reap what they had not sown.

But as with most other good things the patent laws are subject to many abuses, both in the granting of patents, and in the handling of them after they are granted. Already 362,920 patents and 10,834 re-issues of patents have been issued, covering devices for almost every conceivable purpose, and the cost of a patent is so slight and the possible reward from a successful one so great, that the manufacture of new ones is going on at the rate of 25,000 or more per year.

This opens the way to a rich harvest for patent solicitors, while yet making it exceedingly difficult to get a valid patent with claims of any "breadth" which will stand the legal test to which all patents come sooner or later, if of any value. Hence has come about a practice among attorneys of the lower grade (who naturally are the majority) which is well enough understood by those who have had to do with patent law, but which the general public do not understand, for to them—for the most part—a patent is a patent.

This practice is to describe the invention on which the inventor desires patent as fully as heart could wish in the specifications, and likewise show it in the drawings. Whatever is shown there, unless it is "claimed" as new, amounts to nothing, but that the whole pith and marrow of his patent lies in his claim, the average inventor does not understand. The claims are then made as mild as possible, perhaps, to begin with, and if any difficulty arises, one claim after another is dropped or amended until at last there is nothing left which can be denied to be novel; because there is nothing left of any real value.

Sometimes, though more rarely, this process is varied by the deliberate manufacture of new features on which patent can be claimed, and the more worthless they are, the more likely they are to be granted. In very many instances the true interests of the inventor are ruthlessly sacrificed in this process. The patent-office examiner cites three or four old patents perhaps, which he alleges to anticipate the new application. Very often they do not, or only in the vaguest way, but it is much easier to "amend" by cutting out everything which has even the appearance of conflicting with anything so instanced, than to prove the references are irrelevant, and patents by by thousands are annually issued thus stripped of every valuable feature, included among which are nearly all the car coupler patents.

With so very large a proportion of the patents yearly issued of this imperfect character, it is but natural there should be many abuses in the handling of them. One of the most common is to do little or nothing to push the patent, and still less to establish its validity in the courts, but to "lie low" for such small royalties as can be obtained without doing so. If the device has any merit at all there are many who will pay a small royalty without inquiring or even believing in the real validity of the patent, merely to avoid the possibility of trouble. Thus the most imperfect patent has a certain value which makes it worth taking hold of, if it has reference to anything which is of value, especially when the original inventor has grown "tired," and is ready to part with it for a song.

The LATIMER safety guard patent, the facts as to which we have noted elsewhere, is a singular illustration of the way in which nominal "patents" are obtained which are in reality no patents, and cover nothing which is valuable. That the device was a *bona-fide* new invention of MR. LATIMER, and that it was of a kind which, whether new or old in its details, was really new enough in its effect to entitle the inventor in equity to a certain reward from it, we take to be undoubted. Nevertheless, under the strict letter of the patent law, we presume the patent office was right in rejecting the application for lack of novelty, since the converging guide-rails and the re-railing frogs separately are almost as old as railroading, and it can hardly be but that they had been used in combination before 1871. What was then done, however, through the patent solicitors to whom the task of "getting a patent," was entrusted, was to add two entirely new and utterly absurd and useless features to the original device, and claim these *new* features IN COMBINATION WITH the old and good ones.

Were the original inventor still interested in the patent, we should be sorry to even call attention to these facts it it would impede his obtaining that recompense for his design to which he is entitled in equity, if not in law. But as the inventor has long since ceased to be interested in it, we cannot but regard it as fortunate that a safeguard of such solid and great value, which ought to be in use to-day at each end of every bridge and trestle in the United States, and probably in a few years will be, belongs to the public in every essential and valuable feature, and in every feature which is generally used, or is ever likely to be used.

## CORRESPONDENCE.

### A Correction.

BEAVER FALLS, Pa., May 11, 1887.

EDITOR ENGINEERING NEWS:

By an oversight in my letter of April 12, published May 7, I said the *sum* of the ordinates is to be taken as the coefficient of $\frac{w\,l^2}{12\,H}$. I should have said the *half sum*. Other errors more obvious than this I leave for the printers's shoulders to bear.

Yours truly, C. H. LINDENBERGER.

[By a typographical error, the formula given as $\Sigma P (2k - 3k^2 + k^3)$ should read $\Sigma P (2k - 3k^2 + k^3)$. The integral mark $\int$ was also omitted before the formula $\Sigma P = \int w\,l\,d\,k$.—ED. ENG. NEWS.]

### The Latimer Safety-Guard Patent.

*Law Office of H. Harrison, Room 37,*
184 *Dearborn St.*, CHICAGO, Ill., April 12, 1887.

BUSINESS MANAGER ENGINEERING NEWS:

*Dear Sir:*—As the attorney of WM. J. MORDEN, Esq., of this city, I write you in reference to an article which appeared on page 108 of your issue of Feb. 12, 1887, which has caused him damage, and will continue to do so unless retracted by you fully. Mr. MORDEN is the owner, and has been for years, of the patent on the LATIMER safety-guard. In your article you stated that there was no patent on it, which was not the truth. This article has caused a number to infringe, and there is no telling how much damage it will do. I enclose you a copy of a letter from one railroad which shows how my client may suffer. If you will publish an article setting this matter right before the public and send me a copy, you may satisfy my client. It is unnecessary for me to go into detail in this matter, as you will readily see the injury you have caused. Awaiting your reply and prompt action in this matter, I am,

Yours respectfully, H. HARRISON,
Attorney for W. J. MORDEN.

(We have not thought any further reply to this letter was necessary than to do as our correspondent suggests, "publish an article setting the matter right before the public," and we have to thank our legal friend for suggesting that we do this in a way that led us to look into the whole matter. To place all the facts before our readers, it will be remembered that in our next following issue after the Woodstock disaster, we gave a complete report of the facts in regard to it, and also the first illustration of the LATIMER-CHILDS safety guard which has ever appeared, and made an urgent appeal, which we have several times repeated, and expect to continue to repeat, for its general use. The expression to which our correspondent objects was "The Latimer safety-guard (*on which there is no patent*) has been known and approved for over 12 years, and during all that time has been standard on many roads." The statement as to patent was based on information and belief derived from persons in whom we had confidence, together with the fact well known to us that for many years back MR. LATIMER had said that anyone who wished was welcome to use the device. On March 5, (p. 161) in accordance with a note from MR. MORDEN we stated:

"We find we were in error in supposing that the Latimer patent had run out, but the royalty asked is not great, and those unwilling to pay a small price for the best article can use a cheaper one without price."

Again, in our issue of March 12 (p. 175) to make assurance doubly sure, we added:

"The patent for the Latimer rerailing bridge safety-guard is owned by Mr. W. J. MORDEN, of Chicago, Ill (234 South Clark St.). We have already stated that we were in error in supposing that the patent had run out. Patent or no patent, we have nothing to take back of what we have said in its favor, and we understand that the royalty asked is far from high."

Under all these circumstances, considering that we had given this device such an advertisement as it never had before, and is not likely to have soon again, we should have supposed that the balance of benefit was decidedly in favor of Mr. MORDEN, but we can understand that there are circumstances under which no amount of praise of a device can overbalance the injury from a breath of suspicion against the validity of a patent, and we therefore place the record of MR. MORDEN'S patent in full before our readers, to enable them to judge for themselves how much in injury he has suffered from us.—ED. ENG. NEWS.]

### A Water Company Wanted.

*Office of Lookout Water Co.*
CHATTANOOGA, TENN., May 8, 1887.

EDITOR ENGINEERING NEWS:

The southern boom in real estate has been followed by a boom in springs for water-works purposes, and now every man, who has a wet weather spring within ten miles of our city, has visions of a gigantic water-works plant and of "shekels" pouring in from grateful consumers of pure spring water. The latest of these is what may be called the "Green's pond project." This pond or lake lies some 6 miles east of the city, on the other side of Missionary Ridge. It covers some six acres, and is kept alive by springs in the bottom. The overflow will range from 500,000 to 1,000,000 galls. per day according to state of weather. A company has been formed to pump this water over the ridge (an elevation of 400 ft.) into Chattanooga, a distance of 6 miles, to meet a consumption which already exceeds 3,000,000 galls. per day. Those interested seem to think that the overflow has nothing to do with the supply, since there is a large body of water to

draw from. The pond will hold about 30,000,000 galls. or 10 days supply. They would like to get some company to take hold of it, which has in its employ an engineer capable of mastering the trifling problem of 1,000,000 galls. supply, and 3,000,000 galls. consumption.

I write this to show what a boom can do.

Yours very truly, NISBET WINGFIELD.

## The Latimer Safety Guard Patent.

We gave May 7, the drawings and specifications of this patent as finally issued, April 8, 1883. We give herewith a brief abstract of the history of the application. To clearly follow it, reference must be had to the drawing we published May 7.

The application was filed May 4, 1871. The claim is for "an apparatus of guides and lifters for the prevention of accidents and for the saving of life and property," and it is described without any central wooden platform or extension of the guard-rail along the center line of the track, such as were finally made the *sole* subjects of patent claim, as will be seen from the claims published May 7.

June 10, 1871, this application was rejected for want of novelty, as being substantially anticipated by four different patents of dates ranging from 1866 to 1869.

Feb. 6, 1873, or some months within the legal limit of two years for such action, Messrs. COX & COX were appointed his attorneys by Mr. LATIMER, and on Feb. 14, they cancelled the whole specification, except petition and signatures, and introduced a new specification, much as it now appears. The "platform B," "somewhat higher than the rails," etc., etc., is now heard of for the first time, as also the absurd "prolongation D," along the center of the track beyond the point of the "platform B," for "a proper distance." This "platform B," and "prolongation D," are alone made the subject of claim.

On the same date permission was asked and granted to withdraw the model for the purpose of having new drawings made "as those filed with the case are informal."

On Feb. 28, 1873, the claims of this renewed application were rejected in the following very meaty terms:

"In the matter of this application, no function for the "platform B" is anywhere set forth. In the first claim, what is really in combination with the lifters E and F is the guard pieces C (the sloping rails) and it is not seen that these have any different effect from the converging rails of the ordinary form which have been used in the same combination for the same purpose, as can be shown by reference. In any event, the claim is incomplete without the coöperation of the guard pieces C.

"Claims 3 and 4 also amount to the same thing: guards C being omitted from one, and platform B from the other, while both are implied and necessary in each claim."

"Claims 1, 3 and 4 are rejected."

Claim 2, which was not rejected, was for "the prolongation D" beyond the point of the converging rails or platform. The examiners evidently concluded that that was in every sense a novel addition.

This made it necessary to discover or invent some function for the wooden platform, and the attorneys were equal to the emergency. They "amended" the invention on March 6, 1873, by the following precious addendums:

"Page 3, line 27, after the word "distance," insert the following:

"*The space between the guide C is filled with a backing of timber or other suitable material of even height with the guides, and is intended to support the wheel or wheels should the truck run off the rails at a point adjacent the platform; and also to brace the guides one against the other, thus rendering the entire construction compact and capable of resisting lateral pressure.*

"Page 3, line 21, after the word "are" insert the following:

"*composed of bars of metal or other suitable material firmly secured in a vertical position to the backing and are*

"Page 4, line 21, after the word "rail" insert the following:

"*The guides C are found with plain surfaces, that form being preferable to the ordinary T-rail, as being less liable to catch snow.*"

The fourth claim was stricken out altogether.

By this time enough had been put into the specification and taken out of the claims to have something in it that would be accepted as "patentable" and accordingly the application was allowed on March 28, 1873, and the patent issued, in the form in which we presented it last week, on April 8, 1873.

This patent, as we stated, covers nothing but (1) a wooden lozenge shaped platform, faced with flat iron, instead of the usual converging rails, and (2) a straight guard-rail laid in the middle of the track beyond the point of the converging rails or platform. To the best of our knowledge, information and belief, neither one of these addendums ever have been used in a single one of the hundreds of LATIMER safety-guards which have been constructed. Certainly they were not shown in the CHILDS-LATIMER safety-guard which we illustrated in our issue of Feb. 12, 1887, and recommended for general use. NOT A SINGLE FEATURE OF IT IS COVERED IN ANY SENSE BY THE CLAIMS OF THE PATENT OBTAINED IN MR. LATIMER'S NAME BY COX & COX. What more we have to say in this matter is said on the editorial page.

## The Burlington Brake Tests.

The brake tests which began at Burlington, Ia., on May 9, have not yet progressed very far, but far enough to develope some very remarkable results, summarized in part on our first page. The tests, when complete, will probably go far to settle a problem of tremendous importance, the brake or brakes which are to be used hereafter on all the freight cars on this continent. As such they will be watched with universal interest. Nothing intelligible, or at least entirely reliable, can be made out by comparing the bare records of the stops. We shall therefore in all our reports give the comparative efficiency of the brakes *in per cent. to the load on braked wheels*, thus eliminating the effect of the varying speed, the grades (which are not even uniform), the proportion of the weight of the train to which brakes are applied, the train resistance, and other varying causes.

The tests are made by a run over piece a of track about 9 miles long on which four stops are made, the first two "on a level," although neither of them are such in fact, one being on an up-grade and another down, and the second two on a down grade of 1 per cent. (or 53 ft. per mile) but with a good many breaks and irregularities which need to be taken into account.

The first and third stops are made as nearly as may be from a speed of 20 miles per hour, and the second and fourth from a speed of 40 miles per hour. Three successive runs are made for the most important tests. We need not repeat the details of the very complete electrical and other arrangements for taking the stop records. A dynamometer car follows the engine, then the train of 50 cars, and then a way car, the first and last without brakes and used on all trains alike. The braked and total weights of the trains which have so far been tested are shown in the following table.

The stops are numbered thus: All the stops on the first day are numbered 100, on the second day 200, etc. The first sum of each day is 10, the second 20, etc. The units 1, 2, 3 and 4, designate the corresponding stops. Thus, run 320 is the second run on the third day of the tests, and stops 321 and 324 are the first and fourth stops on that run. This system makes the number of each stop a positive thing, and facilitates keeping uniform records on all parts of the long trains, besides having other advantages.

The tests so far made are:

1. Runs with engine and dynamometer car only, to test the engine brakes.

2. Runs with a full train of 50 cars using engine brakes only.

3. Runs with the same train using hand brakes *and* the engine driver brakes.

4. "Gravity runs," so called, for determining the train resistance. These tests are thus conducted: The train approaches stop-post 1 at 20 miles per hour as nearly as may be. Steam is then shut off by closing the throttle (the engines are all inspected to have them perfectly tight) and the train permitted to "float" over the nearly level track as far as its stored energy will carry it, which is two or three miles. The train is then pulled ahead to stop No. 3, at the top of the 1 per cent. grade, passing it at 5 miles per hour as nearly as may be, and it is then permitted to gain what speed it will in the distance of 1¼ miles to stop post 4, which is usually over 30 miles per hour. The train is then stopped by brakes.

5. "Breakaways" or intentional breaking of the train in two, to test the quickness of stop resulting.

6. Stops by the power brakes of 50 car trains, which have been made both with loose slack and no slack, and with and without electric apparatus.

The violence of the impacts are tested by a slidometer, a simple little instrument improvised last year for the purpose, by a happy chance, and answering precisely the purpose required. It consists merely of a clear white pine trough, run over with a smoothing plane but not sand-papered, in which slides a round disc of turned wrought-iron, 5 in. diameter and 3 in. high, with the sharp corners slightly rounded off, weighing 16½ lbs. Theoretically, its motion in inches should be directly proportional to the violence of the impact, and it appears to be so in fact. An impact of 8 to 10 in. is all that is fairly permissible without danger of injury to stock and fruit.

The gravity tests are of the highest technical value, when properly worked up, as indicating the total train resistance of trains in service, including the engine and head resistance. There is a great lack of good evidence on this point, since dynamometer tests do not supply it at all, and the tests made last year at Burlington are the best and most reliable evidence which now exists in regard to it. We shall hereafter compute these tests more carefully, but at present will only say roughly, by comparison with last year's tests, that the Westinghouse and Carpenter trains showed a total average resistance in pounds per ton of entire train at speeds falling from 21 miles per hour of 6.75 lbs. per ton, nearly the same at all speeds. The Eames train showed a little higher resistance of about 7½ to 7¾ lbs. per ton. Last year the Westinghouse train showed only 4.32 lbs. per ton, and the American (entirely new cars) as high as 8.50 lbs.

The breakaway tests were as follows, the distance given being that which the engine ran, after the two halves of the train had parted. The Eames performance is fairly good; the Westinghouse amazingly good. Last year's tests, although made with only 25 cars instead of 50 were much inferior. Without having computed them, we suspect these stops are decidedly the best on record. Stopping a train of 50 cars in 125 ft. from 21 miles per hour, and 211 ft. from 28 miles per hour amounts to an efficiency of 13.35 and 13.22 per cent. respectively. In this connection we may remind our readers that in our discussion of the absence of automatic brakes at the Bussey bridge, in our issue of April 30, 1887, we assumed an efficiency of only 9.5 per cent. Such

*Weight of Trains and Percentage on Braked Wheels.*

| Brake. | Eng. and Dyn. Car. | | | 50 Cars Weight. (Way Car, no brakes.) | | Engine and Train. | | |
|---|---|---|---|---|---|---|---|---|
| | Weight. | | p. c. Braked. | | | Weight. | | p. c. Braked. |
| | Braked. | Total. | | Braked. | Total. | Braked. | Total. | |
| Westinghouse | 41.27 | 69.22 | 59.6 | 764.40 | 783.95 | 805.67 | 853.17 | 94.3 |
| Eames | 41.15 | 69.57 | 59.1 | 640.33 | 659.88 | 681.48 | 729.49 | 93.4 |
| Carpenter | 40 94 | 69.65 | 58.8 | 683.78 | 703.33 | 724.72 | 772.98 | 93.7 |
| Hanscom | 42.00 | 71.18 | 59.0 | 620.17 | 639.72 | 662.17 | 710.90 | 93.0 |

efficiencies as above would have stopped the train in about a car-length less than we then determined, and probably saved—or at least possibly saved—nearly all the lives lost.

week. We are also compelled for lack of space to omit until next week the details as to the relative impacts, etc. resulting from various modes of coupling, and details of the electric appliances.

*Record of Driver Brake Tests and Tests of 50 Car Trains, all Braked.*

| KIND OF TEST. | No. of Run. | Brake. | Stop 1. Speed. | Stop 1. Dist. | Stop 2. Speed. | Stop 2. Dist. | Stop 3. Speed. | Stop 3. Dist. | Stop 4. Speed. | Stop 4. Dist. |
|---|---|---|---|---|---|---|---|---|---|---|
| Engine and dynamometer car; driver and tender brakes only | 110 | West. | 20½ | 248 | 41 | 1035 | 20 | 300 | 40 | 1323 |
| | 220 | " | 21 | 286 | 41½ | 968 | 21 | 259 | 41½ | 997 |
| | 310 | Eames | 21½ | 336 | 40¾ | 1111 | 21½ | 435 | 40¾ | 1374 |
| | 320 | " | 23¾ | 425 | 39¾ | 1060 | 22¾ | 418 | 40¾ | 1331 |
| | 230 | Carp. | 21 | 264 | 41½ | 1283 | 21½ | 367 | 39 | 1505 |
| | 240 | " | 23½ | 231 | 40 | 730 | 20 | 209 | 35 | 590 |
| | | | | | | | | | 45 | 1177 |
| 50 empties. | | | | | | | | | | |
| Non-electric, loose slack | 510 | West. | 19½ | 214 | | | | | | |
| Electric Janney coupler | 520 | " | 17¼ | 184 | 35½ | 586 | | | | |
| | 530 | " | 22 | 181 | 36½ | 453 | 20 | 170 | 40½ | 614 |
| | 610 | " | 20¾ | 155 | 37 | 475 | 21 | 163 | 42 | 665 |
| Non-electric loose slack | 620 | " | 20 | 524 | 35¼ | 1007 | 20¾ | 488 | 39¾ | 1383 |
| Electric, much slack | 630 | " | 22 | 169 | | | | | | |
| Non-Electric | 640 | Eames | 21 | 370 | 38 | 896 | 20 | 386 | 42 | 1191 |

*Breakaway Tests.*

| | Stop 1. Speed. | Stop 1. Dist. | Stop 2. Speed. | Stop 2. Dist. |
|---|---|---|---|---|
| 410 Eames. | 21 | 303 | 30½ | 198 |
| 420 " | 21 | 231 | 29½ | 413 |
| 430 West. | 25 | 148 | 28 | 211 |
| 440 " | 21 | 125 | 28 | 218 |

The combined hand and driver brake tests showed nothing of especial interest. We omit them for the present. The driver brakes only, when acting on the whole train of 50 cars, showed the following results, which are of interest only as showing the comparative efficiency of the driver brakes in long stops and short. It will be of observed that though the stops were very long, because of the small per cent of the total weight to which brakes were applied, yet that the efficiency of the brakes was very high.

*Tests of 50 Car Trains; Engine Brakes only; One Stop (No. 1.) only*

| No. run. | Brake. | Speed. | Dist. | Time. | Av. speed. |
|---|---|---|---|---|---|
| 120 | West. | 20 | 2,589 | 3 min. 5 sec. | 9.55 |
| 330 | Eames. | 20¾ | 1,747 | 1 min. 40 sec. | 11.9 |
| 250 | Carp. | 23 | 2,469 | 2 min 7⅛ sec. | 13.2 |

| No. run. | Vel. head ft. | Per braked wt. | Efficiency of brakes in per cent. of Total wt. | Efficiency of brakes in per cent. of Braked wt. |
|---|---|---|---|---|
| 120 | 14.20 | 4.83 | 0.548 | 11.35 |
| 330 | 15.30 | 5.64 | 0.874 | 15.47 |
| 250 | 18.79 | 5.30 | 0.760 | 14.33 |

[The "velocity head" is the vertical distance through which the energy in the trains would lift it, as given in the table on page 282 of our issue of April 30, 1887.]

The above tables illustrates clearly the process of computing the efficiency of any brake, which is this:

$$\text{Efficiency of brakes in per cent. of total weight on } \textit{braked wheels.} = \frac{\frac{V}{n} \pm g - r}{p}$$

in which $V$ = velocity-head in feet due to the speed.
$n$ = distance run in stations of 100 ft.
$g$ = rate of grade per 100, — if up, + if down.
$r$ = "grade of repose" corresponding to rolling friction of train (taken at 0.4, or 8 lbs. per ton.)
$p$ = per cent. of total weight of train to which brakes are applied.

The absolute weight of the train does not enter into the formula, although it is commonly used in computing brake efficiency, which is done in an unnecessarily laborious way. The above formula is general for all conditions except when the grade is broken. When that is the case, certain vertical corrections are necessary, making a change in the value of $V$. It is also necessary to remember that it is the center of gravity, and not the head of the train which must be worked from.

We shall not attempt in this issue to tabulate the efficiency of more than the engine driver brakes, since it will be more profitable to do so when there is a full list for comparison, as there will be next

RELATIVE PER CENT. OF BRAKE EFFICIENCY.

*Engine and Tender Brakes, Engine and Dynamometer Car Train.*

| | Run. | Stop 1. | Stop 2. | Stop 3. | Stop 4. | Average. |
|---|---|---|---|---|---|---|
| Westinghouse ... | 1st. | 9.87 | 8.33 | 8.95 | 8.21 | 8.84 |
| | 2nd. | 9.08 | 9.27 | 11.17 | 11.33 | 10.21 |
| | Av. | 9.47 | 8.80 | 10.06 | 9.77 | 9.52 |
| Eames ... | 1st. | 8.30 | 7.63 | 8.63 | 8.25 | 8.20 |
| | 2nd. | 8.10 | 7.61 | 8.47 | 8.41 | 8.15 |
| | Av. | 8.20 | 7.62 | 8.55 | 8.33 | 8.17 |
| Carpenter ... | 1st. | 10.08 | 6.74 | 8.64 | 7.30 | 8.18 |
| | 2nd. | 14.41 | 11.87 | 12.53 | 13.53 / 11.41 | 12.75 |
| | Av. | 12.25 | 9.30 | 10.58 | 10.75 | 10.72 |

[The efficiency of Stop 2 was low in all of these runs, which was not the case last year, and looks like an error of calculation, but it cannot be detected, if it is.]

## PERSONAL.

G. W. NELLES has been appointed City Engineer of Leavenworth, Kan.

A. G. WRIGHT has been appointed Roadmaster of the Louisville, New Albany & Chicago R. R., between Indianapolis and Michigan City, Ind.

E. B. THOMAS has been appointed General Manager of the East Tennessee, Virginia & Georgia R. R., with headquarters at Washington, D. C.

GEORGE E. HOWE, for many years Master Mechanic of the St. Johnsbury & Lake Champlain R. R., died May 7 at St. Johnsbury, Vt.

THOMAS GUERIN, C. E., of Montreal, died at Ottawa, Canada, May 7. He had been engaged on many of the public works in Canada.

S. B. CALLAWAY, General Manager and 2nd Vice President of the Union Pacific R. R. Co., has resigned his position.

ROBERT MOORE has been appointed Consulting Engineer of the St. Louis Bridge Co. & Tunnel R. R., to succeed the late C. SHALER SMITH.

JAMES GOWAN, of Strasburg, Pa., died at Chicago, May 9. He built the water-works and part of the crib, and constructed part of the Hoosac tunnel.

CAPT. J. W. PARRISH, has been appointed Superintendent of the Second Division of the Georgia Pacific R. R., with headquarters at Birmingham, Ala.

J. T. STONE is Chief Engineer of the Augusta & Chattanooga R. R., with headquarters at Augusta, Ga.

MAJOR J. S. MORRISON is Chief Engineer of the Georgia, Carolina & Northern R. R., with headquarters at Athens, Ga.

W. B. PARSONS, Jr., is now Chief Engineer and General Manager of the Denver Railroad, Land & Coal Co., with headquarters at Denver, Col. The colliery of the company is at Scranton, Col.

J. R. HARDY, Superintendent of the Kansas City, St. Joseph & Council Bluffs R. R., has resigned to accept a position with the Kansas City, Fort Scott & Gulf R. R. Co. His resignation will take effect June 1.

H. F. SMITH has been appointed Assistant Superintendent of the South and North Alabama Divisions of the Louisville & Nashville R. R., with headquarters at Birmingham, Ala.

S. FISHER MORRIS is promoted from Assistant Engineer to Division Engineer on the New Croton Aqueduct. He will succeed J. B. MCINTIRE on the Fourth Division.

CHIEF ENGINEER CHURCH, of the New Croton Aqueduct, has been allowed $1,500 by the Aqueduct Commissioners to defray the expenses of the investigation of the charges preferred against him by ex-Constructing Engineer CRAVEN.

Messrs. R. M. BERRIAN, J. S. DEANS, J. A. FULTON, W. F. GOODRICH, J. R. HUDSON, F. A. LEERS, J. G. MACKLIN and D. L. SMITH, were elected Members of the American Society of Civil Engineers at its last meeting, May 4, as announced more fully in another column. Mr. R. J. PRATT was elected Associate, and Messrs. E. B. GOSLING, A. M. MOSSCROP, E. W. RATHBUN, and W. P. WILLIAMS were elected Juniors.

Mr. FRANCIS COLLINGWOOD has accepted the position of Chief Engineer of the Chesapeake Dry-Dock & Construction Co., at Newport News, Va., where his address will be hereafter. He will retain, however, his New York address, 84 Fulton St. It is proposed, we believe, to construct a large Simpson dry-dock, 600 ft. long, with other connecting works.

JAMES WALLACE PARAMORE, an enterprising citizen and an organizer of railroads, died in St. Louis on May 18, aged about 57 years. Mr. PARAMORE was born in Mansfield, Ohio, in 1830; in the Civil War was first Captain and then Colonel of the 8th Ohio Cavalry and was for many years President of the St. Louis Compress Co. He was the original projector of the railroad last year, reorganized as the St. Louis, Arkansas & Texas Railway Co.

J. D. COOK, C. E., of Toledo, O., will extend his business to include the drainage of towns and cities, and has engaged L. E. CHAPIN as his assistant. Mr. COOK engaged in business in 1850 and has been Chief Engineer of four railroads. In 1872 he was placed in charge of the construction of the water-works at Toledo, since when he has devoted himself to hydraulic engineering, and has constructed water-works in numerous cities. He has devoted much time and study to sewerage and drainage.

J. F. HOLLOWAY, of Cleveland, O., has accepted a position with the firm of HENRY R. WORTHINGTON and will locate in New York City. Mr. HOLLOWAY was for several years President and General Manager of the Cuyahoga Steam Furnace Co., of Cleveland.

JOHN H. RANKIN, of Reading, Pa., has been appointed Master Car Builder of the Philadelphia & Reading R. R.

CHANGES OF ADDRESS, MEMBERS OF THE AMERICAN SOCIETY OF AMERICAN ENGINEERS.

L. F. Beckwith, Metropolitan Telephone and Telegraph Co., 144 Greenwich street, New York City.
Geo. W. Vaughan, Asst. Eng. New York, Chicago & St. Louis Ry., Cleveland, O.
John E. Earley, Ch. Eng. Pacific Division, Mexican Central Ry., Irapuato, Mexico.
Onward Bates, Edgemoor Iron Co., Wilmington, Del.
F. F. Bissell, Ch. Eng. Panhandle Construction Co., Quanah, Tex.
E. L. Corthell, Ch. Eng. Central Missouri Ry., Room 518, Roe Building, St. Louis, Mo.
Geo. B. Francis, Asst. Eng. New York, Providence & Boston R. R., Boston, Mass.
Geo. A. Marr, U. S. Engineer Office, Rock Island, Ill.
Wm. F. Merrill, Gen. Man., Hannibal & St. Joseph R. R., Kansas City, St. Joseph and Council Bluffs R. R., St. Joseph, Mo.
Geo. S. Rice, Executive Engineer, Main Drainage Works, Boston, Mass.
A. W. Wright, Citizens Railway Co., St. Louis, Mo.
Thos. F. Richardson, Div. Eng. Chicago, Santa Fé & California Ry., Chillicothe, Ill.

## TECHNICAL NOTES.

THE estimated yield for 1887 of the Lake Superior iron mines is put down at 5,220,000 tons; an increase of 1,657,984 tons iron 1886. The total value of the raw ore for 1887 is estimated at from $30,000,000 to $35,000,000.

THE irrigation commission appointed by the Governor of the Caucasus has recommended the construction of 3,000 miles of irrigation canals in East Transcaucasia. This would effectively irrigate the whole of the Russian territory south of the Caucasus from Tiflis to the Caspian Sea. This country was one time irrigated and supported a dense population.

E. W. F. NATTER, of the U. S. Geological Survey has just completed a topographical map of Boston, Mass., and vicinity, embracing the territory from Quincy, Mass. to Burlington, Vt., and from Needham to Saugus. It is on a scale of 1-30,000 and is now being engraved at Washington, D. C. It is the most complete map of this section ever made; and while the Government will have the map engraved half-size, the Mass. State Commission is being urged to publish the Boston sheet at least on full scale.

### The U. S. Naval Institute.

The last annual report of the United States Naval Institute, as presented by the Secretary and Treasurer, the late Lieut. JOHN W. DANENHOWER, U. S. N. shows it to be a very live association. The Institute was inaugurated in Oct. 1873 for "the advancement of professional, literary and scientific knowledge in the Navy," with headquarters at the U. S. Naval Academy at Annapolis, Md. It has now a membership of 787, including all classes, and the exceeding value of its publications, and their extent show how well the intentions of its projectors have been carried out. Aside from its regular membership it has large number of subscribers and exchanges, and the published quarterly edition of its Proceedings amounts to 1,350 copies. The Institute also has branches in Washington, New York, Newport, Norfolk, and Mare Island, Cal., and also in the Asiatic, European and North Atlantic stations of the Navy. It's income from dues, publications etc., in 1886 was $3614·20; and it has a reserve fund in bonds of a face value of $2,250. The President for 1887 is Rear-Admiral E. SIMPSON, U. S. N.

ACCORDING to a press disaatch this week, an old bridge over the Avon River, near the town of Windsor, Nova Scotia, was burned, which was over 50 years old and a quarter of a mile long. It was probably some philanthropist that burned it.

## SOCIETY PROCEEDINGS.

**The American Society of Civil Engineers.**—At the meeting on Wednesday evening, May 18, President WORTHEN in the chair, the Secretary read a paper by Prof. A. J. DU BOIS on "Formulas for the Weights of Bridges." The author had deduced what he termed rational formulas for determining the weight of plate girders and their economic depth; weight of wind bracing and bridge trusses of varying types and their economic depth, and gave a mathematical discussion of these formulas and a series of tables deduced from them.

This paper was discussed by Mr. H. B. SEAMAN, Prof. J. A. L. WADDELL, Mr. A. GOTTLIEB, Prof. P. C. RICKETT, Mr. CHAS. J. MORSE, Mr. H. C. JENNINGS, Mr. ED. THACHER, Mr. GEO. H. PEGRAM, Mr. WM. M. HUGHES, Mr. CHAS. E. EMERY and Mr. THOMPSON.

The Secretary announced to the members that he had a number of applications for engineers wanted upon railroad work, and asked that the names of engineers seeking employment, together with their record, be forwarded to him. The Secretary also announced that no material change had been made in the Convention programme as fixed at last meeting, other than it had been decided to leave New York on one of the regular Albany day boats (about 9 A. M.), on Friday, July 1. A photograph of the completed plan for the new Harlem bridge was exhibited and also a photograph of a peculiar late bridge wreck in New York State, caused by a horse on the track at entrance to the bridge.

**The American Institute of Electrical Engineers.**—The fourth annual meeting of this Institute was held at the House of the American Society of Civil Engineers, Tuesday Evening May 3d, when the following officers were elected.

*President*, T. COMMERFORD MARTIN, of New York.
*Vice Presidents*, NORVIN GREEN, of New York. Prof. W. A. ANTHONY, of Cornell University, GEORGE C. MAYNARD, of Washington, D. C., FRANK L. POPE, of New York, ROWLAND R. HAZZARD, of New York and Prof. ELIHU THOMPSON, of New York.
*Secretary*, RALPH W. POPE, of New York.
*Treasurer*, GEORGE M. PHELPS, of New York.
*Managers*, S. F. SHELBOURNE, of New York, Capt. O. E. MICHAELIS, Corps of Ordnance, U. S. A., M. Am. Soc. C. E., West Troy, N. Y., Prof. CYRUS F. BRACKETT, of Princeton, N. J., C. O. MAILLOUX, S. S. WHEELER, Assoc. Am. Soc. C. E., JOSEPH WETZLER, A. C. FOWLER, WILLIAM LEE CHURCH, and E. P. THOMPSON of New York.

The second session for the transaction of business and discussion of Technical subjects was held Wednesday morning at 10 A. M. Addresses were made by the retiring President Mr. FRANK L. POPE, and incoming President Mr. T. COMMERFORD MARTIN.

The following papers were read and discussed:

"Novel Phenomena of Alternating Currents:" by Prof. E. THOMPSON.

Practical Experience with Storage Batteries:" by E. P. ROBERTS.

"The Installation of Arc Lighting Plants:" by J. A. POWERS.

"The Differing Temperature Coefficients of the Different Coils of a fine Rheostat:" by Prof. W. A. ANTHONY.

"On the change from Negative to Positive of the Temperature Coefficients of some Carbon Filaments:" by Prof. W. A. ANTHONY.

"The Best Ratio of the Section of the Gramme Armature to the Section of the Field Magnets:" by DUGALD C. JACKSON.

"Lead Encased Conductors;" by DAVID BROOKS.

A resolution was adopted directing the Council to take up the subject of permanent quarters and to proceed at once to solicit subscriptions. During the meeting $1620 were subscribed by the members present towards this object.

## Answers to Correspondents.

S. M. H.—The bridge report of the New York State Commission is not yet out, and will not be for some time. The report will probably be distributed on application and not sold, according to the senseless practice with government publications. Early application to the Commission will probably ensure a copy. If on sale, we shall have it.

INQUIRER.—The Yale & Towne Manufacturing Co., of Stamford, Conn., are, we believe, the chief builders of locomotive and all other cranes in the country. Details as to the various cranes which they manufacture can be be obtained of them.

D. H. A., Augusta, Ga.—Some enterprising engineer has gotten up a diagram of sewers, from which, at a glance, one can see the necessary size, knowing the quantity discharged per second, and "vice-versa." I have misplaced the copy I had, and am anxious to procure another. It was in pamphlet form, and, I think, contained only about four or five pages. I think the sizes ran up to about 3 ft. I will thank you to inform me where I can get another, and the price.

[Without knowing the name of the author we cannot be certain about the pamphlet needed, but the nearest we know of that will "fill the bill," is "Kutter's Formula and its Application to Circular Sewers," by ROBERT MOORE and JULIUS BAIER, of St. Louis. Reprinted in pamphlet form from the Journal of the Associated Engineering Societies for Aug., 1886.—ED. ENG. NEWS.]

W. W., Pittsfield, Mass.—Where can house numbers of card board with tin clips to hold them, in which one or more numbers may be placed for temporary house numbering, be obtained?

The Atwater Manufacturing Co., and H. D. Smith & Co., both of Plantsville, Conn., are leading manufacturers of clips for all purposes; R. H. Smith Manufacturing Co., of Springfield, Mass., supply door numbers in any style.

F. E. M., Co. Surveyor, Chehalis, Wash. Ty.—Dunn's "Land Laws" is out of print. None for sale. Bellows' and Hodgman's Manual of Land Surveying, price $2.50, is specially prepared for western land surveyors. Johnson's "Theory and Practice of Land Surveying," price $3.50, is the best book on land surveying published in any language.

H. C. G., Winnipeg, Can.—For a book "giving the practical information necessary for the construction of railway buildings, etc., etc.," we refer you to "Engineering Structures for Railroads and Highways," by R. B. Osborne, C. E., Philadelphia. Price $6.00, advertised in ENGINEERING NEWS, page XIII, May 14, 1887.

J. D. BUCHANAN, 734 Market St., Philadelphia, Pa.—Having devised a simple, effective, and almost automatic mode of irrigation, I wish to place it on the market. Unable, at this time, to visit New York, make note, if you please, of a faithful party here, to whom I may give the chief heads of a general plan whereby waste waters may be made of great utility, inland or seaboard? The presence of drouth may be averted; railroad lines of travel made dustless; fires thereon quickly put out; and, in many modes, a new era made for town and country—plain and mountain.

Respectfully referred to parties interested in irrigation methods.

## TRADE NOTES.

OUR American manufacturers are more particular this year in sending out feelers for foreign trade. Mr. A. STRAUS, manager of the Vulcanite Emery Wheel Department of the New York Belting & Packing Co., New York, sailed for Europe on the 11th inst., in search of business.

## STATISTICS OF NEW WATER-WORKS CONSTRUCTION.

*(Specially Communicated.)*

CONTINUED FROM PAGE 321.

*Camden, N. Y.*—The works were commenced July 26, 1886; they were designed by E. S. SMALLEY, who was also Constructing Engineer. The contractors for the entire work were Sherman & McDonough, Troy, N. Y., and the price paid for trenching and pipe laying ranged from 24 to 40 cts. There is no stand-pipe. The franchise is owned by the corporation; ROBT. FRAZIER is President of the Water Board, and N. G. DUBOIS, Secretary. The present population is estimated at 1,900.

*Lincoln, Ill.*—The works were commenced May 1, 1886, and accepted Oct. 12, 1886. E. G. FERRIS was Consulting Engineer. The contractors were Moffett, Hodgkins & Clarke, Watertown, N. Y.; the pumping machinery was supplied by the Gordon & Maxwell Co., Hamilton, O.; the pipe and specials by the Lake Shore Foundry, Cleveland, O.; the hydrants by the Galvin Brass & Iron Works, Detroit, Mich., and the valves by Stephens, Scott & Co., Detroit; the stand-pipe, 100 ft. high, was built by Riter & Conley, Pittsburg, Pa.; the trenching and pipe laying was done by the day. The franchise is owned by the Lincoln Water Works Co., and is for 30 years; the hydrant rental being $60 per annum. J. T. MOFFETT is President; FRANK WATTS, Secretary, and A. J. ALDRICH, Superintendent. The present population is estimated it 8,000.

*Exeter, N. H.*—The works were commenced in July, 1886, and accepted Jan. 1, 1887. The works were designed and contracted for by Wheeler & Parks, of Boston. The stand-pipe is 25 ft. by 60 ft., with a head of 140 ft. The franchise is owned by the Exeter Water Works Co., and is for 20 years; the hydrant rental is $40 per annum. E. G. EASTMAN is President, and CHAS. H. JOHNSON, Superintendent. The present population is estimated at about 4,000.

(TO BE CONTINUED.)

NOTE.—The above statistics of new construction are sent in response to special inquiries sent out by us to contractors, superintendents, engineers and others having to do with new works. We have a special blank for this service, and will be pleased to forward one or more on application. We invite co-operation in this special subject.

## CONSTRUCTION NEWS.

Attention is called to our advertisement of back Nos. of ENGINEERING NEWS for 1886. The "News of the Week" columns alone form a very complete record of contract work in every part of the country. *Absolutely every copy* will be disposed of as rapidly as possible, and as soon as the demand ceases the remaining stock will be sold to the junk dealers. It is now or never for those who want any of these numbers.

### Water.

**The Spring Valley Water-Works Co.**, San Francisco, Cal., has filed a $5,000,000 mortgage in favor of the California Safe Deposit & Trust Co., for the purpose of raising money to take up outstanding bonds which will shortly mature. The mortgage covers all the land, reservoirs, pumping works, flumes, mains, water rights and franchises owned by the company.

**Irrigation in Nevada.**—The reservoir formed by the dam built by the Nevada Land & Cattle Co., near the boundary of Humboldt and Elko counties, is nearly full. It is intended to store water for irrigating several hundred acres of alfalfa in Squaw valley. It is stated that there are many localities in Nevada where the water storage system could be adopted; the construction of the reservoirs requires considerable capital but the value of land improved is increased from the government price to $30 or $40 per acre.

**Attleboro, Mass.**—The consolidation of the districts to be supplied by the plans now under consideration with the North Attleboro district has been approved and favorably reported on by PERCY M. BLAKE, C. E. At North Attleboro a permanent water supply for the several villages may be obtained. For an expenditure of $91,342 the systems of Attleboro and North Attleboro (upon which $100,000 and $130,000 respectively have been expended) can be united and other places also supplied. The report enters into the financial results of the consolidation.

**Waltham, Mass.**—The Water Board has presented its report for 1886, being the fourteenth annual report. The works were constructed in 1872-73 and are owned by the city, the supply is pumped from a filter basin near the Charles river. The pumping plant was built by H. R. Worthington, New York. The estimated population is 15,500. 14,000 on line of pipe and 13,000 supplied. The total consumption for the year was 221,787,505 galls. During the year 8,169.7 ft. of main have been laid, of which 4006.1 ft. were cast-iron, 3,358.6 ft. cement, and 500 ft. 2-in. pipe lined with cement: in addition 272 ft. of 1 and 1¼-in. pipe lined with cement have been laid. Six hydrants and 32 stop gates have been set. There are 32.67 miles of mains, from 2 to 16 ins. diameter, cast-iron, wrought-iron and cement lined. There 178 hydrants now in use. The average pressure is 55 pounds. There are 21 miles of service pipes, from ¾-in. to 6 ins. diameter, cast-iron and wrought-iron cement lined; 1,884 taps are in use, 20 meters and 4 motors. The report includes tables of pumpage, expenses, etc., and is accompanied by a report from T. HOWARD BARNES, C. E., on the extension of the water supply. The Water Commissioners are CHARLES E. GETCHELL, H. L. HOVEY, and J. HARRIS. GEO. E. WINSLOW is Superintendent.

**Chicago, Ill.**—Now that the drainage difficulty has been settled by the Roche-Winston bill, which will shortly become a law, attention will probably be given to the additional water supply facilities which are needed for the South Division. About two months ago plans were commenced for a pumping station near Twelfth street, connected by a tunnel with a submerged

crib, 1½ mile from shore; the cost of works and tunnel being estimated by City Engineer ARTINGSTALL at $1,300,000. During the drainage agitation the matter was dropped, but will now be revived. The new pumping engines for the North and West sides will be tested shortly and are expected to add 24,000,000 galls. to the daily capacity of the works, which will give the city a daily supply of 163,000,000 galls.; North Side pumps, 103,000,000 galls. and West Side pumps, 60,000,000 galls. The consumption during the summer is about 115,000,000 galls. per day.

**Burlington, Ia.**—In consequence of complaints as to the muddy condition of the water supply, it is in contemplation to establish a Hyatt filter plant.

**Syracuse, N. Y.**—A new water company is to be organized by local capitalists. The supply will be drawn from the Salmon river and the works will be constructed as rapidly as possible, as soon as the negociations are completed. A franchise is to be applied for and the hydrant rates are to be lower than those proposed by either of the other companies.

**The Portsmouth, (Va.) Water Works.**—The purchasers of the Portsmouth Water Company met at Portsmouth, Va., on May 12, and reorganized the company by electing a new board of directors, and the following officers:—President, L. B. WARD; Vice President, C. B. WARD; Secretary and Treasurer, ISAAC PECK. The name of the company was changed to the Portsmouth & Suffolk Water Company. Steps are being taken to at once complete the works.

**Sewerage.**—Milford, Mass. The report of the Sewerage Committee has been adopted. The system will cost about $300,000.——Warsaw, N. Y. A sewer, 800 ft. long, is to be constructed at a cost of $1,500.——Winfield, Kan. Plans and specifications are being prepared for a sewerage system.——Sacramento, Cal. Col. GEO. E. WARING has been invited to consult with the City Engineer with regard to the city sewerage.——Santa Cruz, Cal. Bonds for $60,000 have been voted for sewers and other improvements; Col. WARING has designed a sewerage system.

**Water Supply in Nebraska.**—Most of the farms are supplied by wells, 10 or 12 ins. diameter, sunk 75 to 200 ft. to reach the abundant supply which underlies almost the entire State. There are generally about 20 ft. of water. The average price for boring is 15 cts. per ft. for 100 ft., and 20 cts per ft. beyond that depth. The water is hard and generally pure, except in shallow wells near the rivers. The supply is steady. As the water does not come to the surface, pumps driven by windmills are very extensively used. A well fitted up with a windmill costs about $150.

**Water Companies.**—The Consolidated Water Supply Co. has been incorporated at Jersey City by A. B. TURNER, F. M. WHEELER and others, to build waterworks, sewers, reservoirs, etc. Capital stock, $5,000,000.

The Greenville Water Works Co. has been incorporated at Greenville, Miss., by F. L. BATES and others.

The McKinney Water Supply Association has been incorporated at McKinney, Tex., by J. L. DOGGETT, D. F. GARRISH and others, with a capital stock of $40,000.

The San Diego (Cal.) Land Co., of Boston, Mass., will increase its capital stock from $1,500,000 to $2,250,000 for the purpose of constructing an extensive water supply system.

**Water-Works Improvements and Extensions.**—Montreal, Canada. Three new boilers are to be put in at a cost of $15,000.——Woonsocket, R. I. A new tank is contemplated.——Athens, Ga. The water mains are to be extended.——Chattanooga, Tenn. Work is to be commenced at once on the new pumping station and 12 filters will be put in. The improvements will cost $100,000. The old reservoir will be sold. W. S. KUHN is General Manager.——Cincinnati, O. The mains are to be extended to Claryville at a cost of $900.——Oshkosh, Wis. Two filters, with a daily capacity of 500,000 galls., have been purchased for $10,000.——Knoxville, Ia. The city is building the reservoir.——Hastings, Neb. The mains are to be extended 3 miles.——Lincoln, Neb. A group of 30 wells is to be sunk and connected with the present well, giving an extra daily supply by gravitation of 2,700,000 galls. A committee has been appointed to receive bids for the extension. Address M. COOPER, of the Water Committee.——Taylor, Tex. The works will be extended.

**New Water-Works.**—Herkimer, N. Y. A proposition has been submitted to the Board of Trustees to supply the village from tile wells sunk in the flats, the water to be pumped to a reservoir with an elevation of 160 ft.——Bath, N. Y. An election is to be held on the water-works question. — Cape Elizabeth, Me. The Portland Water Co. proposes to supply the town for $2,000 per annum for 40 hydrants; the hydrants to become the property of the town after 15 years; there will be 6 miles of pipe. The works will cost $50,000.——Belleville, Ont. The pipes for the new works are being laid.——Ashtabula, O. Work has been commenced.——Macon, Ga. Plans for a system of water-works with a stand-pipe at the river, have been prepared by Capt. J. C. WHEELER. R. K. HINES may be addressed with regard to new works.——Americus, Ga. A committee has been appointed by the council to arrange for the completion of an efficient system of works.——Wytheville, Va. The city will issue bonds for $60,000 for water-works and electric lighting. Address the mayor.——Greenville, Miss. The city has awarded the contract for works with a daily capacity of 2,000,000 galls.——Meridian, Miss. The works are nearly completed.——Oswego, Kan. Work has been commenced.——Van Buren, Ark. A proposition to build works has been made by A. L. PAYNE, of Richmond, Ind.——Sheboygan, Wis. Work will be begun shortly under the supervision of GEORGE W. MCCREARY.——Bismarck, Dak. A contract has been awarded; the supply will be drawn from the Missouri river and the works will cost about $100,000.——Old Orchard, Me. Address WESLEY G. SMITH.——Marshall, Tex. Address the Water-Works Committee.——Jacksonville, Ala. Address the Jacksonville Land Co.——Gridley, Ill. —— Argo, Ia.——Eureka, Kan.——Valley Falls, Kan.

## Proposals Open.

**Tunnel, Iron Viaduct and Bridges.**—M. SHEARER, City Engineer, Indianapolis, Ind.

**Street Railroad and Dummy Engines.**—R. K. HINES, Macon, Ga.

**Iron, Stone, Timber, Etc.**—For harbors at Buffalo, Dunkirk, Oak Orchard, Olcott, Wilson and Erie. Capt. F. A. MAHAN, U. S. Engineer Office, Buffalo, N. Y.

**Purchase of Old Material.**—Rails (56 lbs.) spikes, broken car wheels, axles, scrap, locomotive and tender (5 ft. 6 ins. gauge), railway scales, machinery from steamer, etc., etc. At Blairton, Ont., on Canadian Pacific Ry., and at Coburg, Ont., on the Coburg & Peterboro Ry. T. P. PEARCE, Belleville, Ont., Canada. May 23.

**Photo-Lithographing.**—Copies of drawings for the lighthouse establishment for the year ending June 30, 1888. Vice-Admiral STEVEN C. ROWAN, U. S. N., Lighthouse Board, Treasury Department, Washington, D. C. May 23.

**Dredging.**—At slip at foot of Division avenue. GEO. RICAED CONNER, Commissioner of City Works, Municipal Building, Brooklyn, N. Y. May 23.

**Fire Engines, Etc.**—Two second size piston steam fire engines, Hayes truck, etc. JOHN ENNIS, Commissioner of the Fire Department, 367 Jay street, Brooklyn, N. Y. May 23.

**Pipe, Castings, Etc.**—Lead pipe, 70 tons; pig lead, 20 tons; special castings, 40 tons; 2,000 shells stop cocks with couplings. LOUIS LESAGE, Superintendent of Water Works, Montreal, Canada. May 23.

**Dredging.**—Hudson river; 30,000 cu. yds. at Covilles Folly, May 23; 30,000 cu. yds. at Round Shoal and 1,000 cu. yds. at draw of upper railroad bridge, May 27. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y.

**Sewers.**—Sewer pipe, 10 and 15-in., basins and manholes. JOHN HUNKELE, Street Commissioner, Newark, N. J. May 24.

**Cement, Stone, Etc.**—Natural hydraulic cement, 800 barrels; broken stone, 275 cu. yds.; Portland cement flooring, 11,100 sq. ft. Col. THOMAS L. CASEY, Office of Building for State, War and Navy Departments, Washington, D. C. May 24.

**Fire Hose.**—Gum hose, 2,000 ft.; fabric hose, 1,500 ft.; with couplings. Samples to be sent. J. ALEXANDER PRESTON, President, Board of Fire Commissioners, Baltimore, Md. May 24.

**Dredging.**—Harbor, docks and middle branch. (All previous bids rejected). N. H. HUTTON, Engineer. Hon. JAMES HODGES, President of the Harbor Board, Baltimore, Md. May 25.

**Road Work.**—Improving the Bladensburg road. WILLIAM LUDLOW, Engineer Commissioner, Washington, D. C. May 25.

**Timber, Bolts, Spikes, Stone, Brush, Etc.**—For White River, Black Lake, Saugatuck and Michigan City harbors. Capt. D. W. LOCKWOOD, U. S. Engineer Office, Grand Rapids, Mich. May 25.

**Street Work.**—Grading, macadamizing and improving. ALBERT L. CHASE, Town Clerk, Middletown, R. I. May 25.

**Railroad.**—Grading and masonry for two additional tracks near Derry, on the Pittsburg division. WM. H. BROWN, Chief Engineer, Pennsylvania R. R., 233 South Fourth street, Philadelphia, Pa. May 25.

**Earth.**—Removing 100,000 to 130,000 cu. yds. of earth for grading. JULIUS PITZMAN, Engineer, St. Louis, Mo. May 26.

**Steam Heating Apparatus.**—Board of School Trustees for Fourteenth Ward, and Board of School Trustees for Seventeenth Ward, Hall of Board of Education, 146 Grand street New York City. May 26.

**Granite Curbing.**—6,000 ft. of 6-in. curbing. A. E. SMYER, City Commissioner, Baltimore, Md. May 27.

**Dredging and Embankment.**—On Potomac river improvement. Lieut. Col. PETER C. HAINS, U. S. Engineer Office, Washington, D. C. May 28.

**City Work.**—*Sewers*; 19,090 ft. of 8, 9, 10, 12, 15, 18, 20 and 21-in. pipe; 20,300 cu. yds. earth and 5,100 cu. yds. rock excavation; 44 manholes, 9 flushing tanks, 33 lampholes, 672 inlets.——*Culverts*; 3,680 cu. yds. rubble masonry in place; 300,000 cu. yds. sewer brick; 19 cu. yds. brown stone; 400 sq. yds. stone paving; 4,600 cu. yds. earth and 700 cu. yds. rock excavation; 3,000 ft. B. M. timber.——*Street grading*; 71,700 cu. yds. rock, 171,100 cu. yds. earth and 27,000 cu. yds. borrow excavation; 14,050 cu. yds. gravel and rolling; 70,850 sq. yds. Telford paving; 30,520 ft. stone curbing; 25,000 ft. plank sidewalk; 136 stone and 118 wooden cross walks; 9,000 sq. yds. stone and 34,200 lin. ft. wooden gutters; 5,100 ft. 24-in. vitrified pipe; 250 cu. yds. rubble; 233 lin. ft. wooden bridge. Work divided in two sections, on First and Third streets. Plans and specifications on file. F. B. EDWARDS, Clerk, Board of Public Works, GUY WELLS, President, Board of Public Works, Duluth, Minn. May 28.

**Street Work.**—The estimates have been made on the following prices: **Paving**: granite, sandstone, macadam, cedar block, prepared wood on concrete, asphalt block, sheet asphalt and brick. $2.75, $2.65, $2, $1.90, $3.25, $3.10, $1.75 per sq. yd.; **curbing**, 20 x 4 and 20 x 5, 85 and 95 cts. per ft.; **gutter stone**, 5 x 12, 75 cts.; **crosswalk stone**, 85 cts. per. sq. ft.; **4-in. drain tile**, 8 cts. per lin. ft.; **grading**, 25 cts. per cu. yd. Plans and specifications at engineer's office. O. M. GARDNER, City Engineer, Lincoln, Neb. May 28.

**Street and Sewers.**—Macadam roadway, 3 miles; brick sewers, 24 to 48 ins. diameter, 2 miles. A. V. POWELL, Superintendent of Public Works. H. G. PROCTOR, Village Clerk, Hyde Park, Ill. May 30.

**Steam Heating, Elevator Etc.**—For new building on Whitehall street. Lieut. Col. HENRY C. HODGES, Dep. Q. M. G., U. S. A., Army Building, Houston and Greene streets, New York City. May 30.

**Levee.**—On the Umatilla river. Embankment, 55,800 cu. yds.; rip rap wall, 9,970 cu. yds.; arch culvert, 75 cu. yds. (Only white labor to be employed.) WILLIAM MARTIN, Mayor, Pendleton, Ore. May 31.

**Dredging.**— Cheboygan harbor, Mich. Lieut. Col O. M. POE, U. S. Engineer Office, Detroit, Mich. May 31.

**Stores.**—For the year commencing July 1, 1887. JOSEPH HICKSON, General Manager, Grand Trunk Ry., Montreal, Canada. May 31.

**Well.**—Drilling artesian well: 12 ins. diameter for 200 ft., below that 8-ins.; bids per foot. L. J. LAMAR, Steward, State Lunatic Asylum, Milledgeville, Ga June 1.

**Bridge.**—Span, 90 ft. C. F. MOORE and L. M. MCCLINTIC, Huntersville, W. Va. June 1.

**Chain, Buoy-Irons, Shackles, Etc.**—For year ending June 30, 1888. O. A. BATCHELLER, U. S. N. Lighthouse Inspector (1st District), Portland, Me. June 1.

**Gas Franchise.**—Works to be erected at once. R. BERGFIELD, Chairman, Gas Committee, Tyler, Tex. June 3.

**Bridge.**—Across Chickasaw bayou. GEO. T. HARDY Clerk, Board of Supevisors, Vicksburg, Miss. June 6.

## Contracting.

**The Maine & New Hampshire Granite Co.** is the new name of the North Jay Granite Co., of North Jay, Me. The company has purchased a large granite quarry in North Conway, N. H., from which it is shipping large amounts of paving blocks to western cities.

**Street Railroads.**—R. K. HINES, Macon, Ga., is advertising for iron rails, cars, and information respecting dummy engines, for a street railroad.——A street railroad will be built at Decatur, Ala., within 3 months. The work will be in charge of A. H. HOWLAND, of Montgomery, Ala.

**Dredging.**—The following proposals for improving New York harbor by dredging the main ship channal in the vicinity of Flynn's Knoll, or from the Swash channel, were opened May 18 by Lieut. Col. WALTER MCFARLAND, U. S. Engineer Office, New York City: Joseph Edwards Dredging Co., New York: 28½ cts. per cu. yd.; total, $285,000. Joseph Cumings, New York: 37½ cts. per cu. yd.; $375,000.

**Pumping Engine.**—The contract for the pumping engines at Cincinnati, O., has been awarded to Henry R. Worthington, of New York, (who was the only bidder) for $119,000. The firm bid for four classes of engines, according to the specifications, $100,000, $119,000, $138,000 and $163,000. The engines are to pump 25,000,000 galls. per day from the Ohio river to the Eden reservoir.

**Bridges.**—The following proposals were received recently by the Department of Public Works, Philadelphia; each bidder made two bids, one for a 3-arch bridge of stone and one for brick arches, in each case the piers and abutments to be of stone: James Sullivan, (stone) $43,000, (brick) $41,000; W. H. H. Achuff, $41,000, $39,900; J. H. Hathaway, (brick) $39,000; P. M. Manus, $39,900, $37,800; H. P. W. McTague, $32,256, $32,056; James Deehan, $32,800, $32,300. The contract was awarded to James Deehan, for stone arches. The contract for a wooden bridge over the Philadelphia & Reading R. R. was awarded to J. H. Hathaway at $1,449.

**Trenching.**—T. F. Maney, of Boston, has the contract for trenching for the gas pipes for the new gas company at Amesbury, Mass. He is also doing the excavating for the opera house at the same place.

**Water-Works Supplies.**—At Pittsburg, Pa., contracts have been awarded as follows: miscellaneous castings, Union Foundry, $1.74 per 100; ferules, McKay Manufacturing Co., $4.80, $5.30, $7 and $8.50 per dozen.

**Stone.**—Only one bid was received for stone for Lock No. 5, Little Kanawha river, and opened May 11 by Major JAMES C. POST, U. S. Engineer Office, Cincinnati, O.: I. V. Hoag, Jr., Pittsburg, Pa.; 790 cu. yds. of dimension stone, $6.50 per cu. yd.; 300 cu. yds. of backing stone, $5 per cu. yd. on barges, and hoisting on top of bank, 50 cts.

**Cleaning Water Pipes.**—At Allegheny, Pa., the Water Committee has awarded a contract for cleaning the pipes and removing incrustations, to Kerr & Lawrence, of Minersville, Pa., at 15 cts. per ft. for 6-in. pipe, 20 cts. for 8-in., 25 cts. for 10-in., and 30 cts. for 12-in. The method has been previously tested. The contract covers 3 miles of pipe.

**Sewers.**—The following proposals have been received by the Commissioner of City Works, Brooklyn, N. Y.: John Bray; 30-in. brick sewer, $3.15 per lin. ft.; 12-in. cement pipe, $1.08 per ft.; 15-in cement pipe, $1.34 per ft.; manholes, $33.50 each; street basins, $38 each. Harris & Maguire; $3.48, $1.08, $1.45, $35, $100. John S. Bogert, $3.75, $1.25, $1.55, $36, $110.

**New Croton Aqueduct.**—The contract for the construction of Shaft No. 13½ on Section 7, has been awarded to O'Brien & Clark, who hold the contract for the work on this section, at $21,315. The Chief Engineer and Consulting Engineer recommended the award as delay and embarrassment would ensue in the work on the section if other parties should be given work upon it. The only other proposal for the shaft construction was from Knapp & Egleston, at $19,375. (The abstract of bids was published on page 307).

**Levee.**—It has been decided that if the levee from Waxhaw, Miss., to the lower end of the Riverton levee be enlarged, as recommended by Chief Engineer WM. STARLING, of the Mississippi Levee Commission, the contract shall be awarded to L. C. DULANEY at 19 cts. per yard; or from Waxhaw to the Rosedale levee at 21 cts., at the option of the engineer. If the enlargement work is not carried out, then the present contract for topping the said levees, at 30 cts. per yd., will remain in force. The total of enlargement recommended in the Chief Engineer's report is 1,337,500 yds., and of new work, 764,000 yds.; a grand total of 2,101,500 yds.

**Street Paving.**—At Albany, N. Y., contracts were awarded May 16, as follows by the Board of Contract and Apportionment: John J. Gallogly; (Columbia street), granite, $2.54 per sq. yd.; new curb, 75 cts. per lin. ft.; circular curb, $1.25 per lin. ft.; relaying old curb, 16 cts. per lin. ft.; crosswalks, 60 cts. per sq. ft.; allowance for cobblestone, 5 cts. per sq. yd.; allowance for old curb, 3 cts. per lin. ft.——Jacob Holler; (Van Tromp street), $2.57, 53 cts., 57 cts., 18 cts., 6 cts., 3 cts., 3 cts. (Central avenue), $2.47, 74 cts., 78 cts., 18 cts., 6 cts., 5 cts., 5 cts. (Lancaster street), $2.57, 53 cts., 57 cts., 18 cts., 6 cts., 5 cts., 3 cts., repaving old granite, 55 cts. per sq. yd. Bids were also received from Anthony N. Brady and Patrick H. Reilly. All the bidders were local parties.

**Machinery for Hydraulic Dredge.**—The following proposals were opened May 14, by Capt. E. H. RUFFNER, U. S. Engineer Office, Quincy, Ill.: For centrifugal pump, capable of raising 6,000 galls. per minute to a height of 25 ft., with suction pipe and stirring apparatus: Goulds & Austin, Chicago, $1,322: Joseph Edwards & Co., New York, $1,720.55: Lawrence Machine Co., Boston, $1,850; Lindon W. Bates, Kansas City, Mo., $3,450: John Specht, Dubuque, Ia., $600 (second hand); L. M. Rumsey Manufacturing Co., St. Louis, $600 (pump only).——For discharge pipes leading to a distance of 500 ft. and a height of 20 ft.: Lawrence Machine Co., Boston, $2,158; Goulds & Austin, Chicago, $2,225: Joseph Edwards & Co., New York, $2,274: L. M. Rumsey Manufacturing Co., St. Louis, $2,867.50.

**Grading and Sewer.**—At Duluth, Minn., the contract for grading Michigan street has been awarded to Youngren & Gleason at the following prices: earth excavation, 40 cts. per cu. yd.; rock excavation, $1.37; borrow, 57½ cts.; gravel and rolling, $1: total, $41,204. Proposals were also received from Coolidge, Truax & Wolf, $43,781; Cooley & Smith, $59,248, and Steele & Fitzpatrick, (informal).

The contract for a sewer on Michigan street has been awarded to Youngren & Gleason: wooden outlet, $3 per lin. ft.; 2 ring brick sewer, 4 ft. 7 ins., $5.52; 3 ft. by 4 ft. 6 ins., $5.82; 2 ft. 10 ins. by 4 ft. 3 ins., $4.82; 27 ins., by 40 ins., $3.97; 18 ins. by 27 ins., (1 ring) $1.40; 20-in. pipe, $1.47 per ft.: 24-in. pipe in concrete, $3.13; piles in place, $3.54 each; timber, $17 per M.; manholes, $78 each; lamp holes, $10.68; flushing tank, $99.64; inlets, $2.78 each; rubble, $3.30 per cu. yd.; earth excavation, 90 cts.; rock excavation, $6.25; sand, 84 cts.; total, $42,666.54. The only other bid was from Steele & Fitzpatrick, which was informal.

**Pipe Laying.**—The Water Committee, Pittsburg, Pa., has awarded a contract to Eugene Scanlon for laying 43,000 ft. of 4, 6, 8, 10 and 12-in. pipe at 34¾ cts. per ft.; and to M. Gallagher for laying 5,360 ft. of 4-in. and 22,658 ft. of 6-in. pipe at 23 cts. per ft.

**The Pond Engineering Co.** has issued a gem of a trade catalogue for 1887; setting out in handsome typography, excellent cuts and plain expression, the very varied character of the steam and hydraulic machinery manufactured and handled by this firm Address, 707-709 Market St., St. Louis, Mo.

**Sewers.**—At Toronto, Canada, the Committee on Works has awarded sewer contracts as follows: Burns & McCormack, $13,479; John Farley, $6,875.60, $1,076, $981; G. Montgomery, $641, $246; Wm. Jones, $31,948, $1,834; Patterson & Booth, $373, $853, $5,047. Cedar block pavements are recommended for certain streets; and sewer extensions are also recommended.

**The Lehigh Valley Creosoting Co.** was organized at Perth Amboy, N. J., on April 14, and has leased the Perth Amboy Creosoting Works, built last year by the Lehigh Valley R. R. Co. The new company will conduct a general lumber and creosoting business. President, H. STANLEY GOODWIN; Secretary and Treasurer, DAVID M. BAIRD; Superintendent, WALTER G. BERG.

**Harlem River Ship Canal.**—After long delays, this work is to be at once commenced under the superintendence of Col. MCFARLAND, U. S. Engineers, and proposals for the work will soon be published. The estimated cost of the improvement is $2,300,000, and the canal is to run fron Randall's Island, in the East river, to the Hudson river, by way of Spuyten Duyvil creek. The work can be finished in two years if the money is appropriated.

**River Improvement.**—The following proposals for improving the Rappahannock river, Va., were opened May 11 by S. T. ABERT, U. S. Engineer Office, Washington, D. C.: E. J. Bailey, New York; constructing crib dike, $6.17 per lin. ft.; constructing pile dike, $6.10 per lin. ft.; constructing and sinking mattresses, $2.17 per lin. ft.; quarrying stone, $3.50 per cu. yd. Duncan A. Gillies, Baltimore, Md.; $7.49, $5.99, $1.49, $1.25. A. Kishpaugh, Fredericksburg, Va.; $5.85, $4.70, $1.25, $1.15.

**Bridge Contracts.**—The Columbia Bridge Co., of Dayton, O., has been awarded the contract for a large iron bridge across the Big Blue river at Beatrice, Neb., for the county commissioners. The contract price is $15,000. ——The Atlantic Bridge Co., of Atlanta, Ga., has been awarded the contract for all the bridges on the Anniston & Cincinnati R. R.——The Canton Bridge Co., of Canton, O., has been awarded the contract for the new iron bridge across the Delaware river at Walton, N. Y. The span will be 200 ft., and the contract price, including masonry, is $9,000.

**Engine.**—The following proposals for furnishing a double cylinder engine for the improvement work at the mouth of the Columbia river, were opened May 5 by Capt. CHAS. F. POWELL, U. S. Engineer Office, Portland, Ore.: Willamette Iron Works, Portland, $1,560 (weight, 13,000 pounds): Union Iron Works, Portland, $1,975; Risdon Iron & Locomotive Works, San Francisco, Cal., $2,200 (weight, 13,000 pounds); Vulcan Iron Works, Chicago, $2,380 (subject to increase of freight rates); Portland Iron Works, Portland, $2,450.

**Beacons.**—The following proposals for building beacons in Florida, were opened May 7 by Major W. H. HEUER, U. S. Lighthouse Engineer (7th District), New Orleans, La.: Wm. L. Campbell, Mobile, Ala.; Fort McRae and Fort Barrancas ranges (4 beacons), $1,375; Escambia and Blackwater bays (2 beacons), $1,280; Escambia and Santa Maria de Galvaez bays (1 beacon), $2,140; Santa Maria de Galvaez bay (1 beacon), $475; total, $5,170. John H. Gardner, New Orleans, La.: $1,960, $1,993, $1,993, $490, $6,436. Andrew Olsen, Mobile, Ala.; $1,890, $2,242, $1,900, $560, $6,592. S. S. Leonard, Pensacola, Fla.; $5,200.75, $4,940.55, $2,536.85, $2,450.25, $15,128.40. All contracts awarded to Wm. L. Campbell.

**Parapet Wall.**—The following proposals for constructing a parapet wall on the west breakwater at Cleveland harbor, O., were opened May 10 by Maj L. COOPER OVERMAN, U. S. Engineer Office, Cleveland, O.: B. S. Horton, Vermillion, O.; white pine, $30.50 per 1,000 ft. B. M.; white oak, $35 per 1,000 ft. B. M.: filling stone, $6 per cord; drift bolts, 3½ cts. per pound: spikes, 4 cts. per pound: wharf bolts, 4½ cts. per pound; removing and replacing decking, $50 per 100 lin. ft.; total, $32,228.——L. P. & J. A. Smith, Cleveland, O.; $30, $30, $5, 2¾ cts., 3 cts., 3 cts., $100, $32,565.——Courtland D. Merry, Burgh Hill, O.: $33, $33, $6.25, 3½ cts., 3½ cts., 3½ cts., $50, $34,132.05.——Kerr, Stang & Gilmore, Lorain, O.; $30, $32, $5.50, 3 cts., 3½ cts., 4 cts., $120.90 $34,210.20.

**Stone.**—The following proposals for furnishing stone, on barge at Fort Stevens wharf, or on cars at Fort Stevens reservation, for improving the mouth of the Columbia river in Oregon and Washington Territory, were opened May 5 by Capt. CHAS. F. POWELL, U. S. Engineer Office, Portland, Ore.: Oregon Paving & Contract Co.; sandstone, 56 cts. per 2,000 pounds; basalt, 63½ cts.; (on car), 95 cts. Patrick O'Neal; sandstone, 68 cts. Hoffman & Bates; basalt, 73 cts. David, Smith & Pacquet; 74 cts.; (on car), $1.05. Vincent Cook, 79 cts. L. Michael, (informal); sandstone, 62 cts.; basalt, 69 cts. All the bidders were Portland parties, and all bids, except where noted otherwise, were for delivery on barge.

**City Work.**—For work on the street next the Mississippi river, at St. Paul, Minn., only one bid was received by L. W. RUNDLETT, City Engineer. No local contractors had the plant to handle it and the contract was awarded to Thos. J. Steers for $66,674, which is considered a satisfactory bid. The work is of a peculiar nature, being in fact the building of a levee along the river bank about a mile and a half, which will require piling, riprapping and, in order to get the necessary dirt, dredging from the river. The work now under contract in charge of the City Engineer amounts to $991,800, and work now being advertised will bring it up to $1,500,000 within two months.

**Water-Works Contracts.**—Charles Schroeder has been awarded the contract for the water-works at St. Paul, Neb., for $19,750. M. RICHARDSON is Engineer.

Reeves & West have been awarded the contract for the extension of the water system at Camden, N. J., for $4,702.

J. F. Langford, of Newton, has been awarded the contract for the construction of the Marblehead (Mass) water-works for $42,000. Work was commenced May 9 and is to be completed by July. The Marblehead Water Co. will furnish water until the Water Commissioners can find an adequate supply to be owned by the town. There will be an ample supply for Marblehead Neck and Clifton.

Sherman & McDonough, Troy, N. Y., have the contract for the storage reservoir at Oneonta, N. Y. at $24,900; removing stumps, etc., $1,200. The work is to be completed in October.

Turner, Clarke & Rawson, of Boston, Mass., have been awarded the contract for the construction of the water-works at Janesville, Wis. They will put in 13 miles of pipe and furnish 180 fire hydrants for $4,200 per annum.

**Railroad Contracts.**—McGinnis & White, Manheim, Pa., have the contract for grading and bridging on the Perry County R. R., in Pennsylvania, 11 miles, for $32,199.90.

Samuel R. Bullock and Wm. Mercer, of New York, have the contract for the construction of the Vincennes & New Albany R. R., from Vincennes, Ind., to New Albany, *via* Jasper. The line to be completed to Jasper by January and to New Albany by May next.

The Southern Contract Co., of Louisville, Ky., has the contract for the construction of the Louisville Southern R. R. from Louisville to Danville, 86 miles. Steel rails, 60 pounds per yard, will be laid.

T. L. James, of Atlanta, Ga., has been awarded the contract for the construction of the Atlanta & Hawkinsville R. R.

Scott Bros., of Rich Hill, Mo., have contracts for 50 miles on the eastern and 50 miles on the western end of the Central Missouri R. R.

McMurtrie & Streeter, Denver, Col., have the contract for the extension of the Denver & Rio Grande R. R. from Glenwood Springs to Aspen, Col., 45 miles.

James C. Wilcoxen, of Rapid City, Dak., has been awarded the contract for ties, bridge timbers, piling, etc., for the extension of the Fremont, Elkhorn & Missouri Valley R. R. north of Rapid City.

George Meily, of Lima, O., has been awarded the contract for the construction of the Peoria extension of the Lake Erie & Western R. R., and has commenced work.

Earle & Co., who have the contract for 30 miles of the Seattle, Lake Shore & Eastern R. R., in Washington Territory, have awarded sub-contracts to Anderson & Ashworth, M. Alloway, Spafford & Co., McBeth & Haren, and M. Parker.

Carlile, Price & McGavock have the contract for the first 35 miles from Pueblo, Col., of the Missouri Pacific line from Pueblo to the State line. Mallory & Fitzgerald, of Lincoln, Neb., have the contract for the balance, about 110 miles.

J. D. Beardsley, of Washington, Ark., has the contract for the construction of the Louisiana North & South R. R. from Gibsland to Homer.

Faley Bros., of St. Cloud, Minn., have been awarded the contract for grading 90 miles of the St. Paul, Minneapolis & Manitoba R. R. from Grand Forks to Pembina, and for building stations. Work will be commenced at once.

Kaufman & Sons have the contract for the extension of the Blue Ridge R. R. from West Union to Walhalla, S. C.

Contracts were let May 10 for the construction of 17 miles of the Sheffield & Birmingham R. R., in Alabama.

Contracts have been let at Winona, Minn., for the construction of the Winona & Southwestern R. R., from Winona to Mason City, Ia.; 25 miles to be completed by January 1888 and the entire line by January, 1889.

## Bridges, Canals, Etc.

**Manchester Ship Canal Co.**—The company has concluded a contract for the construction of the canal for $25,000,000; conditional on the whole capital being secured.

**Lake Erie Harbors.**—The following amounts will be expended on harbor work during the present season: Cleveland, $179,807, of which $30,000 is for a parapet wall on the breakwaters, and the balance in extending the east breakwater. Fairport, $18,536, for piers and dredging. Ashtabula, $29,772. Port Clinton, $2,000 for repairs; $41,000 is required to complete the works. Sandusky, $15,213, for dredging. Huron, $2,997, for repairing piers. $12,000 needed to complete the work. Vermillion, $3,732. Toledo, $121,534.

**Concession for Dock.**—The Colonial Secretary, Barbados, is advertising in the English papers for tenders for the the concession for a piece of land, 150 by 50 ft., adjoining the harbor, and the right to construct a slipway or other form of repairing dock for vessels of 400 tons; also for the lease of land for shops. The use of a Priestman dredger and of a diving bell will be granted to the concessionaire. The annual returns for 1885 show that 846,580 tons of shipping (of which 1,411 vessels were of 400 tons and under) called at Barbados. This is exclusive of inter-colonial craft. The right of purchase at the end of 20 years is reserved by the government of Barbados. Tenders will be received up to Aug. 20.

**Bridge Notes.**—Sheffield, Mass. A committee has been appoined to confer with the county commissioners and the Housatonic R. R. Co., respecting a new iron bridge over the Housatonic river at Ashley Falls. ——Brooklyn, N. Y. The amended bill for the extension of the Brooklyn bridge to Concord street has passed the Senate.——Philadelphia, Pa. A new bridge is contemplated at Walnut street, across the Schuylkill river.——Bainbridge, Ga. A bridge is to be built across the Chattahoochee river, at a cost of $50,000. Address Russell & Brown.——Minneapolis, Minn. City Engineer RINKER states that 40 bridges must be built across the Hastings & Dakota R. R., at a cost of $8,000 or $10,000 each. The railroad company will lower its tracks and build the bridges over the streets that existed when the road was built. The city will pay for half the bridges.——Argentine, Kan. A bridge is to be built across the Kaw river at a cost of $75,000, of which the A. T. & S. F. R. R. Co. will pay $10,000, the county commissioners $50,000, and the city $15,000.——Hannibal, Mo. The Wabash Ry. Co. is preparing to rebuild the Hannibal bridge.——Portland, Ore. The Oregon Railway & Navigation Co. will commence work on the new bridge. GEO. S. MORISON is the Engineer.

## Railroads.

**Grading and Tracklaying.**—*East of Chicago.*—Cleveland & Mahoning Valley R. R. This line, which is leased to the N. Y., Pa. & O. Ry., a part of the Erie system, is to be double tracked from Cleveland to Youngstown, O., 80 miles.——Central Mass. Ry. The rails are laid to Ware, Mass., but the line will not open for passenger traffic till June 15.—— Cleveland & Canton R. R. At the recent annual meeting it was voted to place a $2,000,000 mortgage on the road, to change the gauge to standard. —— Cincinnati, Indianapolis, St. Louis & Chicago Ry. The line from Rising Sun to Lawrenceburg, Ind., recently incorporated in this company's interest, has been placed under construction.——New York, New Haven & Hartford R. R. The quadruple tracking which has been in progress between New Rochelle and Mamaroneck, will be continued to the State line.

*Southern.*—Sheffield & Birmingham R. R. The track on this line is laid for a distance of 51 miles from Sheffield, Ala.; and from the end of track to Nauvoo, 16 miles, the line is located and under contract. —— Florida Midland Ry. Four miles of track have been laid this year, from Ocoee to Gotha. From that point the line is to be constructed at once to Kissimmee, 16 miles; and a line is also to be built from Longwood to Lake Jessup, four miles. The extensions are also projected to Charlotte harbor and north from Apopka toward Jacksonville. E. W. HENCK is Vice-President and General Manager.——Louisville, St. Louis & Texas R. R. Owensboro, Ky., has granted a right of way through the city, and grading will commence immediately at that point. Henderson, Ky., has been asked to guarantee for 15 years the interest on $100,000 second mortgage bonds, and if the proposition is accepted, the line will be completed from Louisville to Henderson by the end of the year. The company has also proposed to the citizens of Hardinsburgh that if they will build a branch from that point to the main line, seven miles, the company will furnish the rails and equipment.—— Maysville & Big Sandy R. R. This line, 145 miles in length, from Cincinnati, O., to Ashland, Ky., is being pushed at all points by the contractors, as the contract date for completion is Sept. 1, and the work is very heavy. Track laying is in progress, and it is hoped to open for traffic by November. The line is in the interest of the Chesapeake & Ohio R. R. CHAS. B. CHILDE is Chief Engineer.

*The Northwest.*—Fairchild & Mississippi Ry. Co. This company was organized last year, and graded 15 miles of road between Osseo and Fairchild, Wis. The directors have voted to lay track on this at once and open the line for business; also to change the name to Sault Ste. Marie & Northwestern Ry., and secure capital for building the line to the Mississippi river.—— St. Paul, Minneapolis & Manitoba Ry. Track is laid from Rugby junction, Dak., to Bottineau, 40 miles. On the Montana extension, track is laid 60 miles west of Minot.——Lake Erie & Western Ry. Grading is in progress between Bloomington, Ill., and Peoria.

*The Southwest.*—The most notable occurrence in the recent record of tracklaying, is the completion by the St. Louis & San Francisco R. R. of the line from Fort Smith, Ark., to Paris, Tex., 169.11 miles. The opening of this line to a connection with the railway systems of Texas is an achievement on which the company is to be congratulated. To Texas the new outlet is almost equal in importance to the recent connection with the Santa Fè system and gives a new short route to St. Louis to compete with the Missouri Pacific line.

*Rocky Mountain and Pacific.*—Denver & Rio Grande R. R. Work begins at once on the extension from Montrose to Ouray, 31 miles.——Southern Pacific Ry. The Los Angeles & Santa Ana branch will be pushed through to San Juan Capistrano. The extension to San Diego will not be built at present.——Mexican National Ry. Grading has begun on the line between Saltillo and San Miguel. When this gap is filled the line will extend from Laredo, Tex., to the City of Mexico, and be much the shortest route to that point from the Eastern States.

**New Companies and Projects.**—*East of Chicago.*—Somerset R. R. The directors of this Maine line voted at their recent meeting to build the 17 miles extension to Bingham, previously mentioned in this column.—— Zanesville & Ohio River Ry. This Ohio company has filed a charter for a branch line——New York Northern R. R. The bill extending the limit of time for commencement and completion of this line, proposed from Schenectady to Ogdensburgh, has passed the New York Senate.——Boston & Quebec Air Line R. R. A company is organizing to build this line, for which a reconnoissance survey was made last March, from Skowhegan, on the Maine Central R. R., to a connection with the Quebec Central extension. Messrs. WEBB & WEBB Waterville, Me., are interested.——Midland Ry. of Indiana. It is proposed to extend the line southeast from Anderson to Richmond.

*Southern.*——Mineral R. R. Co. Incorporated in Virginia to build from Strasburg to Moorefield, Hardy Co., W. Va.——Potomac & Alleghany R. R. & Improvement Co. Incorporated by W. B. COMPTON and others to build a railroad from Alexandria, Va., to the West Virginia State line.——Lynchburg Belt R. R. Co. Incorporated by JOHN W. DANIEL and others at Lynchburg, Va.——W. M. WILSON, Obion, Tenn., is chairman of the committee appointed at a recent railroad meeting at McKenzie, Tenn., to cause a survey to be made for a line of railway from that place to the Mississippi river, about 75 miles.——Fayette County, Ky., is trying to raise $200,000 for the Kentucky Union Ry., Chattanooga, Tenn., $250,000 for the Augusta & Chattanooga, and Gadsden, Ala., $50,000 for the Central R. R. of Georgia.

**Surveys.**—*East of Chicago.*—Baltimore & Ohio R. R. Those in charge of affairs seem to give the newspaper reporters about as much satisfaction concerning the New York extension as they did concerning the famous deal. It is said, however, that the surveys have been made via Jenkintown and thence parallel to the Bound Brook line for most of the way.

*Southern.*—Central R. R. of Georgia. It is reported that surveyors are in the field running preliminary lines for an extension from Carrollton, Ga., to Decatur, Ala., via Jacksonville and Gadsden. This is in pursuance of an agreement with the Illinois Central, which is to build to Decatur from Milan, Tenn.——Cumberland, Moorefield & Southwest Virginia Ry. This new Virginia line is under survey. P. J. GAFFNEY is Chief Engineer.

*The Northwest.*—Chicago, Milwaukee & St. Paul Ry. The Gogebic extension from Tomahawk Lake in Northern Wisconsin has been placed under survey.——A line is reported to be under survey from Mt. Hope, Grant Co., Wis., to Prairie du Chien.——St. Louis & Central Illinois R. R. A line is to be surveyed from the southern terminus at Grafton, Ill., to Quincy. The route will be through Calhoun Co., which is at present without railroad facilities.——Duluth, Red Wing & Southern R. R. Austin, Minn., has voted to have the final survey made at once of the line from Rochester to Austin.

*The Southwest.*—Chicago, Kansas & Nebraska R. R. It is said that P. L. D. LATHAM & Co., who have bought the franchise of the Winfield & Wichita R. R. Co., will build the line and turn it over to the Rock Island Co. The line from Topeka to Herington, 80 miles, has been opened for business.——Chicago, Santa Fé & California Ry. A line is under survey from Carrollton, Mo., to St. Joseph, via Kingston and Cameron.——Ft. Smith, Paris & Dardanelle Ry. This Arkansas line is under survey.

*Rocky Mountain and Pacific.*—Missouri Pacific Ry. The line between Ness City, Kan., and Pueblo, Col., will be located as fast as possible so that construction may be put under way.——Burlington & Missouri River R. R. The surveyors are working on the line to Pueblo.—— Utah Midland Ry. Co.. The Secretary of the Interior has given authority for the surveys for this company's line through the Indian reservations.——South Pacific Coast Ry. A branch is under survey from Felton to the California asphaltum beds, 6 miles.

*The Northwest.*—Ohio & Mississippi Ry. A recent project in which this company is said to be interested is an extension of the Indianapolis, Decatur & Springfield Ry. from Decatur to Springfield, Ill., thence by the O. & M. line to Beardstown, from which point a line would be built to connect with the new Chicago, Santa Fé & California Ry., thence giving a direct eastern line from the Mississippi river *via* Indianapolis.——Minneapolis Terminal Ry. Co. Incorporated in Minnesota by C. S. GOODRICH and others.——Toledo, Ann Arbor & North Michigan Ry. By the terms of the contract just closed with the city of Cadillac, Mich., work is to be begun within 30 days on the extension to that place from the present terminus at Mt. Pleasant.——Chicago, Santa Fé & California. The last branch which the newspapers have located for this line runs along the Mississippi levee, from Ft. Madison, Ia., to Quincy, Ill. ——Duluth, Pierre & Black Hills R. R. Pierre, Dak., has voted $25,000 to this line.

*The Southwest*—Atchison, Topeka & Santa Fé R. R. It is said that the St. Louis & Chicago Ry., recently purchased by this company, will be extended from Pekin, Ill., to St. Louis. Should the Santa Fé system reach St. Louis from the West, as it probably will soon, either by construction or purchase, this extension would naturally follow and would give the company a second line to Chicago.——Chicago, Rock Island & Pacific Ry. A branch line is rumored from Lathrop to Cameron, Mo.——The Council Grove, Hutchinson & Southwestern Ry. Co. has been incorporated in Kansas.——A company is forming at Bolivar, Mo., to build a railroad to Fair Play, ten miles.——The Louisiana & Arkansas Ry. Co., which proposes to build from Brinkley, Ark., to Alexandria, Mo., has asked subsidies from the Louisiana parishes along the line, and will begin preliminary surveys at once. W. C. AGNAW is Chief Engineer.——St. Louis, Arkansas & Texas Ry. At the recent annual meeting held at Texarkana, no less than 71 Texas counties were represented by delegations who presented petitions for extensions. From the nature of the case, most of these committees were doomed to disappointment. The company is, however, extending its lines to no small degree. Besides the line from Mt. Pleasant to Sherman, which is to be finished by July, there will be built within the next twelve months, lines from Lewisville, Ark., to Shreveport, La., from Commerce, Tex., to Fort Worth, from Altheimer, Ark., to Little Rock, and from Corsicana to Hillsboro, Tex.——Waco & Brownwood R. R. The towns along the proposed route of this road are anxious for its construction and willing to subscribe heavily. The St. L. Ark. & Tex. Co. has been asked to build the line by an extension from Gatesville, but as there seems little probability of that being done, it is probable that a company will be formed to build an independent line. Mayor JOHN Y. RANKIN, Brownwood, Tex., is interested.——Marysville, Topeka & Memphis Ry. Co. Incorporated in Kansas to build a line 160 miles in length, from Marysville *via* Topeka, Wellsville & Paola. H. H. BROCKWAY, Wellsville, Kan., is interested.

*Rocky Mountain and Pacific.*—Denver & Rio Grande R. R. The directors have voted to lay a third rail on their line from Pueblo to Leadville and Red Cliff, and to build a standard gauge road from Red Cliff to Aspen. ——Union Pacific R. R. The Idaho Central R. R. Co. has been organized in this interest, and will build at once a line from Nampa to Boise City. Idaho is, with the exception of Indian Territory and Alaska, the only territory of the United States whose capital city is without railroad communication. The 18 miles between Grarmont and Keystone, Col., whose construction the Union Pacific officials have been considering, will not be built this season.——Sacramento & Silver Lake R. R. Co. This company has been incorporated in California to build a line from Brighton, near Sacramento, to Silver Lake, El Dorado Co. J. A. SCOTT, Oleta, Amador Co., is interested.——Two new companies are reported as incorporated at Los Angeles, Cal. The Pasadena, Ramona & Long Beach R. R. Co., by J. B. SHORB and others. The Arcadia & Monrovia Ry. Co., by E. J. BALDWIN.—— Colorado Midland Ry. It is stated that with the completion of the line to Aspen, work will be begun on the further extension to the Utah line, and that the road will eventually be built to Ogden.——Shingle Springs & Placerville R. R. Co. Incorporated in the Southern Pacific interest, to build a line in El Dorado county Cal., 12 miles in length.